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Report of Surface Collection and Testing at 18 Sites Near Abiquiu Reservoir, Northern New Mexico

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ABSTRACT

In May 1986, the U.S. Army Corps of Engineers, Albuquerque District, contracted Mariah Associates, Inc. to perform laboratory and data analysis on approximately 27,000 artifacts. These artifacts had been collected by Mariah during emergency field studies at 18 sites during May and June 1985. The fieldwork was prompted by increased floodpool levels during the late spring and summer of 1985. This study includes site and artifact description and interpretation of collected materials.

Studies based on over 200 obsidian hydration readings and up to four cuts on one artifact demonstrated the strongly multicomponent nature of most of the lithic scatters, even those that appeared discrete, uneroded, technologically coherent, and composed of one material type. The LA 27042 assemblage, for example, produced obsidian dates from the entire range of site occupation and, indeed, spanning the entire range of site occupations in the project area. On the other hand, apparently eroded, surficial, and mixed assemblages, such as the downhill transect at LA 27018, were demonstrated to retain research potential when size-shape analysis, abrasion analysis, and hydration dating were used. Obsidian dating was also used to evaluate the Oshara Tradition and other point classifications; results indicated the Oshara typology was less reliable than three other typologies in terms of agreement with the obsidian dates. The point study also indicated that corner-notched arrow points were in use in the Abiquiu area by the A.D. 700s, and that En Medio-style forms co-occur with small arrow points until Late Developmental/Middle Coalition Period times.

Obsidian dates show greatest overall project area occupation during the En Medio Phase, followed by the Developmental Periods. The Arroyo de Comales cluster is unusual in its evidence of more Developmental Period than En Medio Phase occupation. The radiocarbon dates, seven of which are associated with Piedra Lumbre structures or historical ceramics, are from Anasazi or Historic occupations which produced relatively few obsidian dates. Ceramic dates also indicated post-Developmental Period occupations not often associated with obsidian manufacture or recycling.

A spatial analysis using plots of different lithic artifact types attempted to dissect assemblages on a detailed basis. A small, isolated site (LA 27002) was found to be nearly as strongly multicomponent as a large, complex site (LA 25480). Dated artifacts in both sites tended to occur in concentrations suggesting many spatially overlapping occupations and making dating of activity areas difficult.

A K-means cluster analysis on 36 collection units from 17 sites found that the assemblages could be compared usefully by two variables, percentage of Pedernal chert and percentage of heat treatment. The proportion of Pedernal chert was <u>not</u> significantly correlated with the incidence of heat treatment, however. The lack of a correlation between these two variables reflects the high percentage of heat treatment (92 percent overall) in most of the Abiquiu assemblages. The two site clusters with greatest variability in heat treatment and Pedernal chert percentage show no relationship with distance to the Rio Chama. The Arroyo de Comales sites vary from other site clusters in both occupation period and assemblage characteristics.

The site cluster study also showed that site size and distance from the Rio Chama are directly correlated, with larger sites tending to be farther from the river than smaller sites. Concentrations of water, firewood, and lithic resources along drainages may have been factors in site locations. Another factor may have been location along the Rio Chama travel corridor.

ACKNOWLEDGMENTS

James Talent of the Army Corps of Engineers, Abiquiu Reservoir, was very helpful in facilitating the archaeological fieldwork. The people of Ghost Ranch were kind to feed and house field crews. James Rancier and William Whatley shared valuable information concerning their heat treatment experiments. Ken Lord shared comparative lithic collections with the laboratory staff. William Whatley gave valuable insight into useful criteria developed for the selection of obsidian samples for chronometric analysis.

MANAGEMENT SUMMARY

This report describes the results of laboratory and data analysis of approximately 27,000 artifacts collected during emergency field studies conducted by Mariah Associates, Inc. on 18 sites in the vicinity of Abiquiu Reservoir, New Mexico. The study's objectives are to mitigate adverse effects on cultural resources of an increase in floodpool levels and to provide the Albuquerque District of the U.S. Army Corps of Engineers with information necessary to develop a cultural resources management plan for Abiquiu Reservoir in compliance with Section 106 of the National Historic Preservation Act of 1966. With the exception of LA 51699, all sites were found to possess inherent significance.

Sites in the Abiquiu Reservoir area consist of extensive scatters of lithic artifacts with artifact concentrations and occasional structures. Subsurface deposition is minimal to absent. Nevertheless, virtually all of the sites retain significant research potential. Significance derives from the abundance of various Jemez obsidians in assemblages and the chronometric potential obsidians possess. Virtually all research problems addressed hinge upon chronometric obsidian hydration studies. Study of obsidian rich assemblages using chronometric technique has tremendous potential in unraveling major middle range theoretical issues confronting archaeology today.

PART I

BACKGROUND AND METHODS

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1.0 INTRODUCTION

Jack B. Bertram, Amy C. Earls, and John C. Acklen

This report presents the observational and analytical results of emergency field archaeological studies carried out by Mariah Associates, Inc. (MAI) at Abiquiu Reservoir during May and June 1985, and of the ensuing laboratory studies of recovered data and materials carried out in May, June, July, and August 1986. Studies entailed surface collection and limited subsurface testing at 18 sites threatened by rapidly rising Abiquiu Lake levels, and boat ramp and road construction. Analytical goals were to establish a descriptive and analytical data base for each site that is compatible with previous Abiquiu studies. This goal entailed obtaining chronometric dates for each site, refining the obsidian hydration dating curve for local obsidian varieties, and refining the relative chronology for projectile points and other diagnostics. Finally, intrasite and intersite analyses were aimed at establishing spatiotemporal clusters for different sites and establishing temporal or functional differences among sites. The work was performed under Contract No. DACW47-86-D-0002 and Delivery Order DM0002.

Abiquiu Reservoir is located in the Middle Chama Valley of northern New Mexico, approximately 13 km (eight miles) northwest of the village of Abiquiu. The Abiquiu Reservoir in 1982 consisted of 14,121 acres of land administered by the Albuquerque District of the Army Corps of Engineers (ACOE).

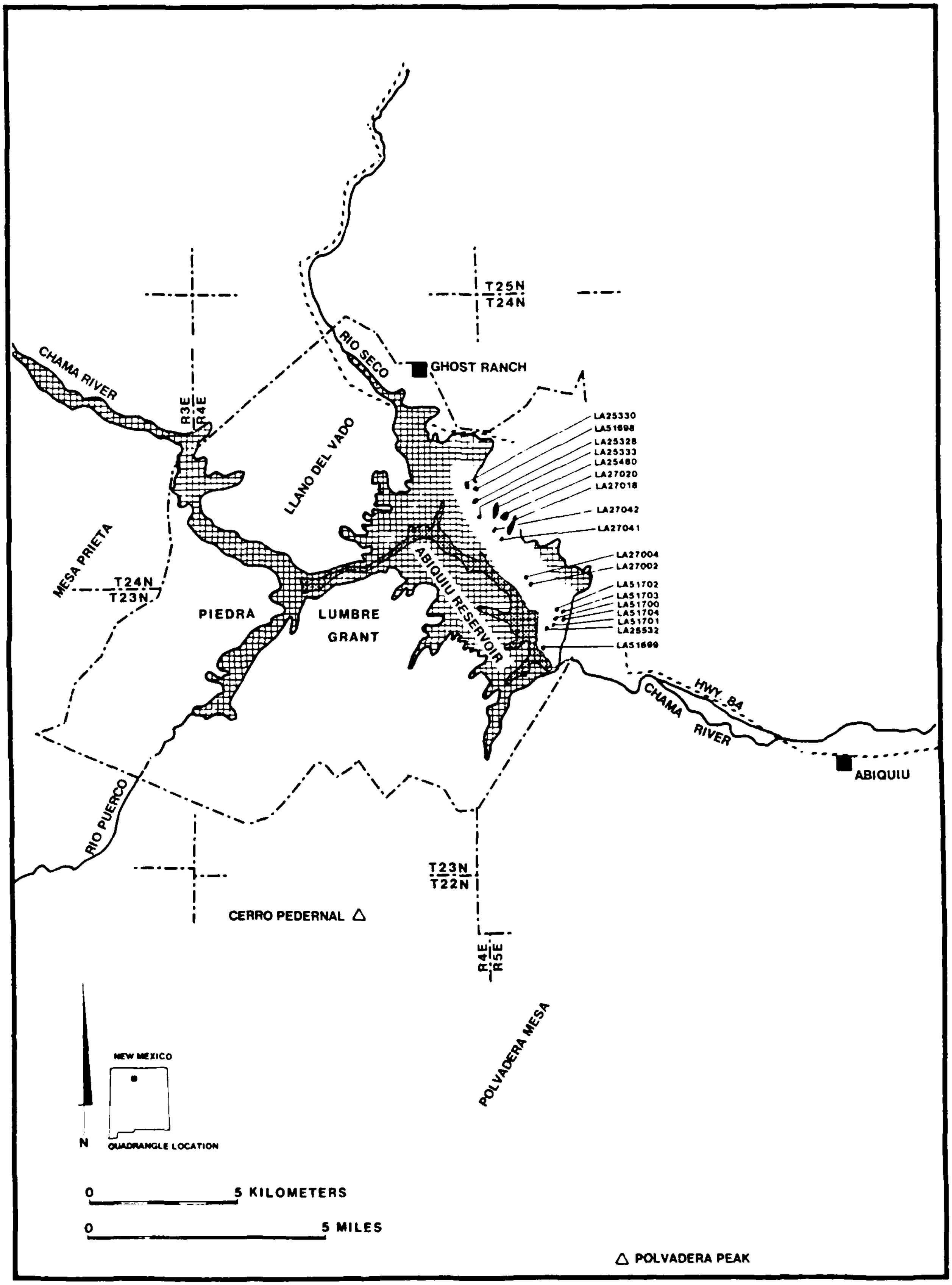
Eleven previously reported sites and seven newly described sites were studied (Figure 1.1). The 11 previously described sites are LA 25328, LA 25330, LA 25333, LA 25480, LA 27018, LA 27020, LA 27041, LA 27042, LA 27002, LA 27004, and LA 25532.

Three previously described sites are in the Llano Piedra Lumbre site cluster. LA 25328 is an extensive, moderate to high density lithic scatter on a ridge top knoll and relatively flat bench south of a small, deeply incised arroyo. LA 25330 is a sparse lithic scatter on a relatively flat bench. LA 25333 is a small, diffuse artifact scatter on the crest of a low ridge.

Five previously described sites comprise the Comanche Canyon site cluster. LA 25480 is a large lithic scatter west and north of the north fork of Comanche Canyon. LA 27018 is an extremely large lithic scatter on an east-west trending mesa south of the south fork of Comanche Canyon. LA 27020 is a large lithic scatter and Piedra Lumbre Phase occupation between the north and south forks of Comanche Canyon. LA 27041 is a moderate density lithic scatter west of LA 27018 and south of the south fork of Comanche Canyon. LA 27042 is a large lithic scatter west of LA 27018 and south of the south fork of Comanche Canyon.

There are two previously described sites in the Arroyo del Chamiso site cluster. LA 27002 is a small lithic scatter on the north edge of a broad, relatively flat mesa northwest of Arroyo del Chamiso. LA 27004 is a small lithic scatter on the western slope of a low, northwest-southwest trending ridge northwest of Arroyo del Chamiso.

Figure 1.1 Site Locations and Project Area, Abiquiu Reservoir, 1989.



Only one previously described site is in the Arroyo de Comales site cluster. LA 25532 is a small lithic and ceramic scatter on the eastern slope of a north-south trending ridge.

One newly described site is in the Llano Piedra Lumbre site cluster. LA 51698 is a sparse to moderate lithic and ceramic scatter and Piedra Lumbre Phase structure occurring from the bottom to the north bench of a small canyon.

Five newly described sites are in the Arroyo de Comales site cluster. LA 51700 is an extensive sparse scatter near the crest of a low, southwest-northeast trending ridge. LA 51701 is a small sparse lithic scatter on a small level area on the same low ridge as LA 51700. LA 51702 is a diffuse lithic scatter on a west sloping area southeast of the Rio Chama. LA 51703 is a large, multicomponent lithic and ceramic scatter on a small, flat bench upslope and east of LA 51702. LA 51704 is a very sparse lithic scatter in a cleared area sloping gradually north-northeast.

The Canada de Chama "group" consists of only one site, the newly described site, LA 51699. LA 51699 is a small structure and lithic scatter site on a small cliff bench directly overlooking the Rio Chama.

The previously reported sites were endangered by inundation and the seven new sites by boat ramp and road construction. From these sites, approximately 30,000 stone, ceramic, bone, glass, and metal artifacts and other samples were collected. Collections and field notes are to be curated at the Ghost Ranch Museum, Ghost Ranch.

The report is organized in the following manner. Part I presents relevant background and methods. The section on environmental setting is followed by a discussion of research orientation. Field methods are presented in Chapter 4 and lithic analysis techniques in Chapter 5.

Part II contains site descriptions based on fieldwork and analysis of lithic assemblages based on laboratory examination. Eighteen sites are described in Chapter 6.

Part III details specialized studies. Studies of intrasite and intersite patterning and site formation processes based on obsidian hydration dates are addressed in Chapter 7. Chapter 8 discusses chronology, including obsidian recycling, C-14 dates, point type dates, and ceramics. Chapter 9 presents a cluster analysis of 36 assemblages from 17 sites and a spatial analysis of LA 25480. Chapter 10 provides details of a study of movement of artifacts downslope on LA 27018. Chapter 11 covers an investigation of ethnohistorical origins of Abiquiu micaceous ceramics. A broad view of Abiquiu occupations is discussed in Chapter 12. Conclusions and recommendations are presented in Chapter 13.

Appendixes present consulting laboratory reports. Included are the obsidian hydration sourcing and dating reports, flotation and pollen studies, lithic formal tool illustrations, lithic formal tools descriptive tables, and K-means cluster analysis tables.

All laboratory work was conducted under the direction of Jeanne Schutt. Schutt authored all lithic descriptions except those for LA 25328, LA 27018, and LA 51703, which were written by Steven Kuhn; Schutt also wrote the lithic summary. Kuhn and Janette Elyea assisted Jack Bertram in producing site descriptions. Illustrations were prepared by Roman Fojud. Bertram directed all theoretically based analyses. Amy Earls assembled the manuscript, addressed reviewers' comments, and edited all sections. Sharon Breitweiser copy edited and produced the first draft. Louella Chavez and Nancy Cochran produced the revised draft. John Acklen served as Principal Investigator.

2.0 ENVIRONMENT

Jack B. Bertram

The Rio Chama Medio in the study area flows through a canyon incised deeply into Permian and Triassic sandstones capped by Tertiary and Quaternary conglomeritic alluviums; these form stepped mesa benches overlooking the river. The Chama Valley probably originated as an anticlinal fold arising from the coupled and relatively recent uplifts of the Brazos/Tres Ritos foothills of the San Juan Range to the north and east and the Jemez batholith domes to the south and west. The valley constitutes the only well-watered, reliably passable route connecting the San Juan Basin to the west with the upper Rio Grande Valley system to the east. As such, it has probably always served as a major travel and migration route for both humans and game animals.

Climatically, the area enjoys relatively cool, wet summers and rather dry, mild winters. Only in December and January does mean temperature fall below freezing; only in July does mean temperature rise above 70^{o} F. (Schander 1986).

Vegetation is typical mountain valley pygmy conifer woodland, with slopes, outcrops, and escarpments being dominated by *Juniperus monosperma* (juniper) with *Pinus edulis* (pinyon) as a subdominant, and areas of gentle slope dominated by grasses, usually *Bouteloua* spp. (grama grasses), *Hilaria jamesii* (galleta), *Sitanion hystrix* (squirrel tail), and *Stipa* spp. (needlegrasses). Larger forms such as *Artemisia* spp. (sagebrushes) and *Atriplex* spp. (four-winged saltbushes) occur both in grass and scrub timber settings. In sheltered canyons, lowland forms like *Salix* spp. (willow) and highland forms like *Pinus ponderosa* (ponderosa pine) may occur. These less arid settings also host various rarer forbs, grasses, fruiting bushes, and other valuable plants.

Animal resources probably found in this favored lowland/upland ecotonal habitat in the PaleoIndian and Early Archaic periods included the Rocky Mountain bison (*Bison bison*; sbsp. *athabaskae*) and certainly included both elk (*Cervus elaphus canadensis* var. *novimexicana*) and bighorn sheep (*Ovis canadensis*) as year-round residents until the recent past. Still present are pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*) as well as jackrabbit (*Lepus californicus*), cottontail (*Sylvilagus auduboni*), and the occasional snowshoe hare (*Lepus americana*). Other mammalian food or fur sources would have included wolf (*Canis lupus*), coyote (*Canis latrans*), lion (*Felis concolor*), bobcat (*Felis* [Lynx] *rufus*), various mustelids, and the larger rodents, especially prairie dog (*Cynomys gunnisoni*), marmot (*Marmota flaviventris*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethica*), and porcupine (*Erethizon dorsatum*).

Avian resources would have included turkey (*Meleagris gallopavo*), various raptors (*Falconiformes*), migratory waterfowl and shorebirds (*Anseriformes* and *Charadriiformes*), and smaller galliform birds such as grouse and quail and columbiform birds, especially doves (*Zenaida macroura*) and bandtail pigeons

(*Columba fasciata*). Aquatic food sources may have been limited to cutthroat trout, channel catfish, various suckers and chubs, and crayfish. Most edible turtles probably could not have tolerated the cold waters of the Rio Chama.

General paleoenvironmental reconstruction for the area rests on the studies of Schoenwetter (1979), Bohrer (1986), and Clary (1986). These studies all suggest that the essentially montane Abiquiu Reservoir area has probably experienced only minor shifts in temperature and precipitation regimes since the end of the Pleistocene (Schander 1986:3.11-12).

All sites treated in this study are located on the east side or left bank of the Rio Chama. Sites are on ridges, benches, mesas, and knolls, generally adjacent to named or unnamed drainages tributary to the Chama. Major tributaries in the project area from north to south are Comanche Canyon (north and south forks), Arroyo del Chamiso, and Arroyo de Comales. Sites also occur on the broad Llano Piedra Lumbre north of Comanche Canyon and on a low bench adjacent to the Rio Chama. Site vegetation is dominated by grama grass, sagebrush, and saltbush with occasional juniper and pinyon.

3.0 RESEARCH ORIENTATION

Jack B. Bertram, Amy C. Earls, and John C. Acklen

This chapter provides a cultural historical background for the Abiquiu area covering major stages of occupation through time. Previous research in the project area is summarized, and research goals are presented.

3.1 CULTURE HISTORY AND PREVIOUS ARCHAEOLOGICAL RESEARCH

This section summarizes the culture history of Cordell's (1979a) Chama archaeological district. The area includes the Chama River Valley and its tributaries, and, where relevant, the Pajarito Plateau and the northern Jemez and Sangre de Cristo Mountains. These landforms include the greatest physiographic relief in the state. The area generally coincides with Thoms' (1977) study area for defining projectile point typologies. Within each section, important previous archaeological research in the area is also discussed.

3.1.1 PaleoIndian Period

The north central New Mexico region has sustained human occupation for at least 12,000 years. However, recent radiocarbon dates from several sites in North America have been published which suggest that early man's presence in the New World could have occurred as early as 20,000 or 30,000 years ago (Adovasio et al. 1977, 1980). At present, material remains from these early hunters and gatherers are limited to rare surface finds, but PaleoIndian occupation of the region may well be more extensive than current data would suggest.

Research on the PaleoIndian Period has been hampered by problems in locating sites because of their great age and the intervening geological processes of deposition and soil formation that cover cultural remains. Adding to this problem is low site visibility, which reflects low population densities and the ephemeral nature of remains left by hunters and gatherers. Also important are problems of site recognition due to the relatively few artifact types diagnostic of this period and the lack of detail in paleoenvironmental reconstruction (Cordell 1979a). PaleoIndian materials are most likely to be found on extremely stable land surfaces or in areas that have experienced considerable erosion exposing old land surfaces.

Three major divisions of PaleoIndian adaptation have been proposed, based primarily on the appearance of a series of diagnostic projectile point types. The Clovis phase has been variously dated to 9,500-9,000 B.C. (Irwin-Williams 1965, Irwin-Williams and Haynes 1970), or 10,000-9,000 B.C. (Agogino 1968). The succeeding stage of adaptation, called Folsom, has been dated to approximately 9,000-8,000 B.C. (Agogino 1968, Judge 1973) and marks a trend towards specialized hunting practices. Folsom materials have frequently been found in association with the extinct *Bison antiquus*. The Plano Phase closes the PaleoIndian occupation of the North American continent and incorporates a number of distinctive technological traditions. These include the Agate Basin

(8,300-8,000 B.C.) and Cody (6,600-6,000 B.C.) Complexes (Irwin-Williams and Haynes 1970). Post-Folsom groups appear to have been highly specialized big game hunters, with a reliance on bison (Stuart and Gauthier 1981). There may have been a return to a more generalized hunting strategy during terminal PaleoIndian times as evidenced by the use of less generalized projectile point types.

In the Rio Chama area, PaleoIndian projectile points manufactured from Pedernal Peak cherts and chalcedonies as well as from Jemez obsidian clearly document that early hunters and gatherers were exploiting lithic sources in the Jemez and Chama areas as early as Clovis times. For example, the Los Encinos artifacts from a chert quarry near Cerro Pedernal suggest quarrying activities dating to the Clovis Period. Other surface finds include those in the southern Sangre de Cristos (Cordell 1979a). Reed and Tucker (1983) report projectile points in association with lithic materials, and Schaafsma (1976) describes a single secondarily deposited cultural horizon of unknown age from Abiquiu Reservoir. Clovis materials are reported from near Tesuque (Warren 1974), Folsom-like materials from Canones Mesa (Lent et al. 1986), and Plano forms including Meserve (Schaafsma 1976) and Cody Complex (Lord and Cella 1986) from the reservoir study area proper. Nothing more is known of early materials, except that Lord (1986:12-5) speculates that "the high incidence of PaleoIndian materials on the northern side of the reservoir between Comanche Canyon and Arroyo del Chamiso may be significant." Unambiguously PaleoIndian sites with strong temporally diagnostic artifact associations in good context are yet to be recognized in the Chama area and would comprise a very important resource.

3.1.2 Archaic Period

Succeeding the PaleoIndian Period is the Archaic, characterized as migratory hunting and gathering cultures seasonally exploiting a diverse resource base (Schroeder 1976). Irwin-Williams and Tompkins (1968) feel that PaleoIndian groups withdrew from the northern Southwest to the north and east, and that the Archaic occupation represents an influx of peoples from the west. However, Stuart and Gauthier (1981) and Judge (1982) disagree and argue for an in situ development of the Archaic Tradition out of a PaleoIndian base.

Archaic remains have been known from north central New Mexico for decades. Renaud's (1946) Rio Grande Complex was probably based in part on Rio Chama collections; it included point forms ascribable to the types Jay, Bajada, San Jose, Scoggin, Mountain Side-notched, etc. It remained for Honea (1969, 1971) and more particularly Irwin-Williams (1973) to formalize the Early and Middle Archaic for north central New Mexico, for Warren (1974) to formally report its presence in the Rio Chama Medio, and for Thoms (1977) to begin the task of local typological formalization.

Aikens (1970) and Thomas (1973) propose that the Archaic Stage, as it is manifested in the arid West, may be identical with Jenning's (1964) "Desert Culture". The Desert Culture concept has been described as a widespread uniform culture characterized by a hunting and gathering way of life during the period 8,000-3,000 B.C. (Martin and Plog 1973). However, at least two traditions and several successive stages of adaptation have been defined

within the Desert Culture. The Cochise and the Oshara Traditions have long been thought of as spatially distinct, with the Cochise south and west of the Oshara. However, recent evidence (Baker and Winter 1981) suggests that the two traditions may merge to some degree in the Jemez Mountains and/or exhibit a boundary in the region.

3.1.2.1 Cochise Tradition

The Cochise Tradition (Sayles and Antevs 1941, Jennings 1964) is composed of three stages of development based on settlement patterns, subsistence mechanisms, and projectile point morphologies. These are the Sulphur Springs Stage (8,000-6,000 B.C.) the Chiricahua Stage (6,000-4,000 B.C.), and the San Pedro Stage (1,900 B.C. to A.D. 1). Early pit structures first appeared during the San Pedro Stage. No pottery occurred during any of these stages, although limited agriculture can be inferred from the presence of maize recovered for Chiricahua Stage sites such as Bat Cave (Dick 1965) and Danger Cave (Jennings 1957). Beckett (1973) defines the Cochise culture area as bounded by southeast Arizona on the west, Interstate 40 in New Mexico on the north, the San Andres Mountains on the east, and northern Mexico on the south. Since Beckett's work, however, laterally thinned projectile points have been recorded throughout southeast Utah and the Colorado Plateau as well as northwestern New Mexico (Baker and Winter 1981), suggesting that the original boundaries for the Cochise culture area may be larger than originally defined, and may in fact include the north central New Mexico area.

3.1.2.2 Oshara Tradition

In contrast to the Cochise Tradition of southern Arizona and New Mexico, the Oshara Tradition (Irwin-Williams 1970, 1973) has been specifically applied to north central New Mexico and seems to have begun around 5,500 B.C. and ended around A.D. 400. It is generally grouped into Early Archaic (Jay, Bajada, and San Jose Phases) and Late Archaic (Armijo and En Medio Phases) based on the introduction of limited maize horticulture at the beginning of the Armijo Phase. It should be noted that, while generally useful in northern New Mexico, the chronology outlined by Irwin-Williams may not necessarily be directly applicable to Archaic Period adaptations in north central New Mexico.

Population size appears to have been relatively stable during the Jay and Bajada Phases (5,500-4,800 B.C. and 4,800-3,200 B.C.), with an increased rate of population growth during the San Jose Phase (3,200-1,800 B.C.), based on the increase in the size and number of sites, located primarily in canyon heads. During the Armijo Phase (1,800-800 B.C.) the settlement pattern seems to replicate that of the Early Archaic except for a seasonal population aggregation at canyon heads accompanied by a slight decrease in the total number of sites. During the En Medio Phase (800 B.C. to A.D. 400), the population increased significantly as reflected by higher site densities.

As early as 1934, Frank C. Hibben recorded lithic scatters measuring several acres in extent on the terraces adjacent to the Rio Chama. Numerous Archaic Period lithic scatters were recorded during the School of American Research (SAR) Abiquiu Project. Snow (1983) recorded 176 sites of Late Archaic affiliation, and Archaic-Basketmaker II sites account for the single

most common site type in the vicinity of Abiquiu Reservoir (Schaafsma 1978b). This work indicates a long period of Late Archaic use of river terraces. Since the Abiquiu sites do not seem to differ functionally, Schaafsma (1976) suggests they represent one aspect of a seasonal round, the complementary seasonal activities perhaps occurring at higher elevations (Cordell 1979a). Beal (1980) notes that the larger Archaic sites in the Abiquiu region exhibit evidence of site reoccupation in the form of multiple hearths and projectile point styles that span multiple time periods (Anschuetz et al. 1985). Warren (1974) recorded several sites containing diagnostic artifacts, suggesting Bajada through Basketmaker II occupations located along the west slope of Cerro Pedernal. During the San Juan to Ojo survey, Enloe et al. (1974) documented a number of ceramic and lithic scatters located adjacent to the lower Rio Chama Valley and in the Piedra Lumbre Valley, one of which (LA 11836) was excavated by Snow (1983). Lang (1979) recorded seven lithic scatters with Late Archaic or Basketmaker II materials near the confluence of the Rio Chama and the Ojo Caliente River.

The Chambers Consultants and Planners (CCP)-ACOE Abiquiu Project's efforts to more exactly define the local Osharan Archaic typological chronology appear to have established that the reservoir area was occupied throughout the Archaic (7,500-1,500 B.P.) and that the Osharan typological chronology is inappropriate for study of the area. Lord's (1986) bewilderment with an abundance of very young hydration dates for "old" projectile point forms is understandable. His data strongly suggest that Early and Middle Archaic types were later routinely recycled and newly manufactured. In the reservoir area, Late Archaic types yielded obsidian hydration dates indicating manufacture from Middle Archaic to Pueblo Coalition Period times.

It appears that these obsidian dates are, overall, relatively reliable (see Chapter 8): the chronologically well-understood corner-notched arrow point (CCP-ACOE type 4) dated on 24 specimens to A.D. 484 ± 717; those probably arrow or dart-arrow transition En Medio types with relatively narrow haft widths (CCP-ACOE types 6A and 6C) dated to A.D. 660 ± 764 and A.D. 446 ± 405, respectively, on a total of 23 specimens; and those true side-notched arrow points (CCP-ACOE type 3) dated on three specimens to A.D. 1398 ± 382. These dates for dart-arrow transition points, corner-notched arrow points, and true side-notched ("Pueblo") arrow points are entirely consistent with our expectations and knowledge, or perhaps even a bit too old. The late CCP-ACOE dates for supposedly earlier Osharan projectile forms consequently call the entire, hitherto poorly-dated, Osharan typological sequence into question, at least for the northern Rio Grande-Rio Chama region.

One serious difficulty in many of these studies is that the temporal identification is based on a few, or even a single, Archaic style projectile point(s). This approach ignores the possibility of repetitive reuse of site loci, not to mention artifacts, over long periods of time. It is probable that many of the sites currently identified as Archaic also have significantly later components. Conversely, many undated lithic scatters may be Archaic but lack temporally diagnostic artifacts. This problem can be fruitfully addressed by a systematic program of obsidian hydration analysis of nondiagnostic debitage materials.

3.1.3 Anasazi Period

The Anasazi, or Puebloan, occupation of the region has been classified according to Kidder's (1927) Pecos scheme as well as by the more geographically specific Upper Rio Grande sequence of Wendorf and Reed (1955).

3.1.3.1 Developmental Period

Evidence of Developmental Period (ca. A.D. 400-1200) occupation in the western half of the north central New Mexico area is very sparse. The Pajarito Archaeological Research Project recorded a single Developmental site in an 11 percent sample of 621 km^2 on the Pajarito Plateau (Hill and Trierweiler 1986). The lack of Developmental Period habitation sites strongly suggests a hiatus in occupation between the Archaic (i.e., Late Basketmaker) and the early Coalition Period (i.e., middle Pueblo III). Occasional surface finds of Basketmaker III projectile points suggest that the Developmental Period use of the area may have been restricted to seasonal hunting episodes.

In the Chama District nine Basketmaker III-Pueblo I points were located by Schaafsma (1976) within the Abiquiu Reservoir area. These points are found on sites lacking in ceramics, structures, hearths, or other artifacts suggesting no more than temporary use of the district during Basketmaker-Pueblo I times.

3.1.3.2 Coalition Period

In contrast to the Developmental Period, there is much more direct evidence for Coalition Period (ca. A.D. 1200-1325) occupations in the project area. This occupation is marked by significant population growth and an expansion of permanent sedentary settlements by agriculturalists into areas of higher elevation.

Many ceramic period sites are known from the reservoir area; those sites predating the late Classic Period are typically aceramic. Later prehistoric ceramics are also rare in the area, except near the large sites of Riana (LA 920), Palisade (LA 3505), and Tsiping (LA 301). Stone architecture appears to be virtually absent, again with the exception of the major sites (Lord 1986:12.44). Earlier sites seem to lack the expected pithouse or pithouse/jacal architecture so typical of the Basketmaker, Developmental, and Coalition Pueblo Periods elsewhere and appear to be En Medio-Late Archaic both chronometrically and typologically (Lord 1986). Emphasis on use of heat-treated lithic materials became more important in Puebloan times, relative to the Late Archaic (Lord and Cella 1986). Overall, the Puebloan occupation of the Abiquiu Reservoir area appears anomalous in its general absence of architecture and ceramic usage and in its emphasis on high-quality lithic reduction including heat treatment technology.

Information from sites of this period in the Chama District has been obtained primarily through the excavations conducted at Riana Ruin (Hibben 1937), Leaf Water Site (Luebben 1953), and Palisade Ruin (Peckham 1959, 1981). These communities have been tree-ring dated to the early and mid-1300s (Anschuetz et al. 1985). Recent excavations in the Abiquiu area on Coalition Period sites include LA 11830, a seasonally occupied field house and garden plot complex (Enloe et al. 1974, Fiero 1976) and LA 20325, a large garden

complex (Lang 1979, 1980, 1981). Peckham (1981) reports that habitation settlements were typically widely scattered along the Rio Chama and its tributaries during the Coalition Period. However, he views the placement of Palisade Ruin, which is located on a high mesa overlooking the Chama drainage, as evidence that demographic factors compelled agriculturalists to exploit areas previously considered marginal for agriculture (cf. Anschuetz et al. 1985). Hibben (1937) distinguished between Wiyo and Biscuit sites in size and site plan. The Wiyo sites, which include Leaf Water, Riana Ruin, Palisade, and LA 3505, are roughly quadrangular, with room blocks on three sides of a plaza closed on the fourth side by a palisade of jacal or a line of stones. The Wiyo sites contain Santa Fe and Wiyo Black-on-white and small amounts of St. Johns Polychrome and are dated to A.D. 1200-1375.

Nondiagnostic lithic scatters are common in the Chama District. One of these, LA 11828, when excavated yielded considerable quantities of fire-cracked rock; corrugated, Abiquiu Black-on-gray (Biscuit A), and Tewa polychrome sherds; and points comparable to those from large Pueblo III-IV sites in the area.

Pueblo III sites range in size from 1-2 rooms to more than 200 rooms. The most common site size is 13-30 rooms. Most are small linear or L-shaped roomblocks. The largest roomblocks are on the northern Pajarito Plateau, with many arranged around an enclosed plaza (Stuart and Gauthier 1981).

In the southwest portion of the project area, an important and significant sample of Coalition Period sites was recorded by the Pajarito Archaeological Research Project (Hill and Trierweiler 1986). This sample included 248 early Coalition sites, 172 late Coalition sites, and 85 undifferentiated Coalition Period sites. In comparing the early to late Coalition Period occupations of the Pajarito Plateau, among the conclusions reached were 1) a significant increase in mean pueblo floor area from 175 m^2 to 387 m^2, 2) a significant increase in total site frequency, and 3) a net increase in total floor area (and, hence, inferred population) by 40 percent.

3.1.3.3 Classic Period

The Classic Period (ca. A.D. 1325-1600) postdates the abandonment of the San Juan Basin by sedentary agriculturalists. It is characterized by Wendorf and Reed (1955) as a time of general cultural florescence. Regional populations attained their greatest levels; large communities with multiple plaza, kiva, and roomblock complexes were occupied; and material culture underwent substantial elaboration. The beginning of the Classic Period in the northern Rio Grande area coincides with the appearance of locally manufactured red-slipped and glaze-decorated ceramics, the Glaze A wares, in the Santa Fe, Albuquerque, Galisteo and Salinas Districts after ca. A.D. 1315 (Mera 1935). In the Jemez, Pajarito, and Chama areas, carbon painted black-on-white wares, such as Wiyo Black-on-white and later Biscuit A and B, continued to be manufactured (Cordell 1979a).

The large biscuitware sites of the Chama District and the Pajarito Plateau have been the subject of archaeological investigations since the turn of the century. The Biscuit sites date to the Classic Phase. The Biscuit sites include Po-shu-ouinge, Te'ewi, Sapawe, Tsama, Howiri, and others. While the Wiyo sites range from an estimated 25 to 100 rooms, the Biscuit sites

contain many hundreds of rooms. Ceramics include Santa Fe and Wiyo Black-on-white, plus Biscuit A and B, Potsuwi'i Incised, corrugated, and mica plainwares. Tradewares include Galisteo Black-on-white, St. Johns Polychrome, and Rio Grande Glazes. Small sites occupied in high uplands bordering the Chama Valley during Wiyo times were apparently abandoned when the larger pueblos appeared in the Pajarito Plateau and Chama areas. Recent investigations of Classic Period sites in the Chama District consist primarily of limited contract projects at Ponsipa-akweri and excavations of portions of Howiri within the US 285 construction right-of-way (Fallon et al. 1981).

The Pajarito Archaeological Research Project recorded 321 Classic Period sites, including 183 dating to the early Classic, 110 to the middle Classic, 18 to the late Classic, and 10 undifferentiated Classic (Hill and Trierweiler 1986). In comparing the early, middle, and late Classic periods, some of the conclusions reached were 1) an increase over time in mean pueblo floor area from 899 m^2 to 2,864 m^2, 2) a decrease in site frequency by a factor of 10, 3) a decrease in total pueblo floor area (and, hence, inferred population) by 4.4 percent, 4) an overall decrease in site elevation, 5) an increase in defensive site features, 6) an increase in total storage capacity, and 7) an increase in the diversity of exploited resources.

The Anasazi occupation of the Rio Chama Valley during the Classic Period may be a pattern of gradual withdrawal downstream toward the Rio Grande (Schaafsma 1979). Mera (1934), Wendorf (1953), and Wendorf and Reed (1955) assert that this contraction of settlement culminated shortly before A.D. 1600 with the abandonment of the entire district by permanent year-round Anasazi agriculturalists. Mera (1934) further cites absence of any mention of the numerous ruins in the region as evidence that the communities were no longer occupied at the time of the Spanish entradas. Whether the large Pueblo IV sites were occupied on a year-round basis at the time of contact is questionable. Ellis (1975), citing the presence of sheep and cattle bones at Sapawe and a piece of metal from Tsama, believes they were occupied year-round. Schaafsma (1979) feels that the historic artifacts may only represent seasonal use of these sites by Pueblo herdsmen. Three sites in the Chama District contain Tewa Polychrome and were probably occupied historically; these are the site underlying the Chapel of Santa Rosa de Lima de Abiquiu, Greenley Ruin, and San Gabriel de Yunque (Cordell 1979a).

3.1.4 Historic Phase

3.1.4.1 Protohistoric Occupation

Despite much research, it is not certain when the first southern Athabaskan peoples entered into the Southwest. Dates have been suggested as early as A.D. 1000 (Kluckhohn and Leighton 1962) and as late as A.D. 1525 (D.A. Gunnerson 1956). However, it seems probable that by the early sixteenth century, Athabaskan-speaking groups that had emigrated south from points in northern Canada were established on the plains of Texas and New Mexico (D.A. Gunnerson 1956, 1969; Gunnerson and Gunnerson 1971; Hester 1962; Vogt 1961). Dinetah Gray pottery and chronometric dates from the A.D. 1300s through A.D. 1680 indicate Athabaskan occupation in the La Plata Valley during these times (Earls et al. 1988). One area that the Navajos appear to have settled was along the upper San Juan River and in Largo and Gobernador Canyons (Kelley 1982). Dittert et al. (1961) place the first occupation of the Navajo

Reservoir District at 1550, and Keur (1944) dates that of Gobernador Canyon at 1656. Schaafsma (1978b) asserts that the presence of Navajos in the Chama River Valley between A.D. 1620 and 1710 indicates that the Navajos were part of the general movement of the Apacheans into the Pueblo area and that they were not a unique wave of Athabaskans that early settled northwestern New Mexico.

Navajos nevertheless shared in the Pueblo Revolt of 1680 (Reeve 1959, Brugge 1968). During the Reconquest, Navajos aided the refugees. More permanent settlement by the refugee population, by this time probably well mixed with the Athabaskan element, seems to have begun between 1710 and 1715 in the canyons tributary to the San Juan. Sites of this period are characterized by pueblitos, small pueblo-style structures of one or more rooms, usually built in defensive locations and with associated hogans, towers, and defensive walls (Carlson 1965). Pottery of this time period includes Dinetah Utility, Gobernador Polychrome, and non-glaze trade polychromes. During this phase, which ended around 1800, there was a shift from forked stick hogans to stone masonry, cribbed log hogans as well as the addition of domesticated livestock such as horses, cattle, and sheep.

There is some indirect evidence that Navajos occupied the Pajarito Plateau during early historic times. The name "Navajo" may be derived from "Navahu'u", the Tewa name for LA 21427, a pueblo site in the Los Alamos area (Harrington 1916). The Tewa site name was apparently mistakenly applied by the Spanish explorers to the recent Dine' immigrants who were temporarily occupying the area. Regardless, Navajos clearly lived adjacent to the Tewa villages of Santa Clara, Tesuque, Pojoaque, San Juan, Cochiti and San Ildefonso Pueblos, and are described as living in *rancherias* and practicing agriculture (with large planted fields) as well as animal husbandry (cf. Hodge et al. 1945, Ayer 1916). Further, Redondo Peak is one of the sacred eastern mountains, and Navajos are known to have made pilgrimages to its top (Baker and Winter 1981). It is probable that the Navajos also utilized the lithic resources available at Polvadera and Pedernal Peaks throughout the seventeenth and eighteenth centuries. The survey of Abiquiu Reservoir by the SAR recorded 33 sites believed to be historic Navajo settlements ranging from habitation sites to lithic and ceramic scatters located on the second or third bench of the Chama.

A wealth of sites in the reservoir area conforms to the characteristics Schaafsma (1972, 1981) ascribed to the Piedra Lumbre (A.D. 1640-1740) Phase--namely, circular, stacked-stone masonry structures, evidence of ovicaprid husbandry; lithic and metal technology; and early historic ceramics. Schaafsma (1979), Beal (1980), Klager (1980), Reed et al. (1982), and Reed and Tucker (1983) all viewed the Piedra Lumbre Phase as an early Navajo occupation.

Kemrer (1987) dissents from this view, arguing persuasively that most Piedra Lumbre sites are of Tewa origin. Carrillo (personal communication 1985) and Bertram (1984) have observed that similar assemblages could equally pertain to other ethnic groups engaged in herding or in raiding herds, and that later herders, raiders, travelers, or hunters may have routinely reoccupied Piedra Lumbre structures, which might themselves be expected on occasion to represent frugally refurbished Coalition or Classic Period field

houses. Sites LA 25293 and LA 25532 Feature B appear to confirm these expectations (Kemrer 1987:17-20).

Carrillo (1987a) suggests that the stone masonry circular to subrectangular Piedra Lumbre structure bases reflect a pastoralist adaptation as opposed to a cultural indicator of Navajo occupation as suggested by Schaafsma (1976). Carrillo cites documentary evidence supporting a pastoral adaptation on the part of Tewa peoples during a period prior to the wholesale adoption of that subsistence practice on the part of the Navajo. This argument has enormous potential for the reevaluation of assignations of ethnicity in the Abiquiu area and is deserving of further attention and evaluation.

Navajo settlements may have extended south of Abiquiu into the lower Rio Chama Valley during the seventeenth century. However, no indisputably Navajo sites have been documented there, and documentary data are sparse on the lower Rio Chama Valley from the abandonment of San Gabriel in 1610 to the Spanish reconquest in 1692. By the beginning of the eighteenth century, when Spanish settlement extended into the Chama Valley, it is apparent that Navajos were being pushed west by a combination of Spanish pressure from the south and Ute pressure from the north and east (Anschuetz et al. 1985). Conflict between Spanish and Navajos was acute throughout the late eighteenth century. Constant Navajo raiding of *rancherias* and their depredations of Spanish sheep flocks resulted in the fortification of Spanish homesteads with stockades and *torreones*.

Lodge and tipi ring sites are numerous in the Chama Valley area and are generally ascribed to the Navajo or Ute. Hibben (1937) describes the lodges as built of posts and split beams set vertically on end and joining at a central apex, with the bases of the posts supported by boulders and sandstone slabs (Cordell 1979a).

Archival evidence suggests that, besides the Utes and Apaches, Navajos and Tewas visited the reservoir area for trading and raiding purposes from the seventeenth to late nineteenth centuries. The Jicarilla Apaches are recorded west of the Rio Grande at only two times, 1694 and 1818, before the American period, settling in the area after 1846. The Comanches were infrequent but memorable raiders of the Chama Valley for a few years in the mid-eighteenth century. Documentation of the period from 1598 to 1760 mentions the Navajos in the Piedra Lumbre Valley only in association with raids on Spanish and Pueblo settlements, particularly during the 1704-1713 period. Tewa occupation of the Chama Valley lasted until the early seventeenth century, with continued use of the reservoir area in the 1620s to obtain piedra lumbre (alum) for dying cloth and Pedernal chert for stone tools. Tewa traders moved through the valley to reach Ute territory. Tewas may well have herded sheep in the area, producing the Piedra Lumbre structures (Wozniak 1987).

Hispanic expansion into the area occurred during the first half of the eighteenth century. Sheep camps in the reservoir area during the nineteenth century are described as canvas tents apparently held down by stones and pegs forming a circular structure; most cooking was done outside (Carrillo 1987a).

Thus, at least seven ethnic groups are documented in the Chama Valley from the time of Spanish contact to the late nineteenth century. Of these,

the Comanches are not likely to have left structural evidence, and the Tewas are not believed to have used tents or tipis (although they may have built brush structures with stone supports at the base). The Navajos are also reported to have raided in the valley; the extent to which their presence is monitored in the archaeological record is a subject of debate.

3.1.4.2 Hispanic Occupation

Following the Spanish reconquest of New Mexico in 1692-1696, the northernmost frontier of Mexico was permitted to redevelop (Snow 1979). The seventeenth and eighteenth centuries saw a rapid increase in the number of Spaniards; however, it does not appear that Spanish immigrants successfully settled the Chama River Valley past the present dam area until about 1806. The Spanish, Utes, and Jicarillas all occupied the valley from 1806 to 1881. In the late 1870s, the village of Tierra Amarilla assumed the role of administrative and commercial center of the Rio Chama region. For centuries, the Chama Valley has been the natural land route for trade and transportation between the Rio Grande Valley and the San Juan Valley to the north. After the 1970s, the Rio Chama ceased to be a major artery of traffic and trade, which may explain why the Chama Basin today remains an enclave of traditional Hispanic culture in northern New Mexico (A.H. Schroeder 1953, Anschuetz et al. 1985).

Within the Abiquiu Reservoir District, Schaafsma (1976) investigated 14 Spanish sites, including five Territorial Period homesteads. Ceramics from the Colonial Phase sites consist of ollas, bowls, and jars from the Rio Grande pottery centers as well as from the Zia area. The question of an indigenous Spanish pottery tradition is somewhat problematic. It has been suggested that Mexican Indians brought in by the Spanish immigrants may have produced pottery using identifiable Mesoamerican techniques (Hurt and Dick 1946, Chapman and Biella 1977, Riley 1974). Many vessel forms from Historic Period ceramics, such as hemispherical bowls, ring-bases, and soup-plate forms appear to reflect Spanish design influence. In fact, Carrillo (1987b) asserts that much of the pottery attributed to Rio Grande pueblos in the Abiquiu area may in fact have been locally manufactured by Hispanics as late as the 1940s.

3.2 PREVIOUS RESEARCH IN THE ABIQUIU RESERVOIR AREA

Archaeological and ethnographic research in the Abiquiu Reservoir vicinity is rooted in the earliest Spanish records of the occupation of New Mexico (Hammond and Rey 1940:244, 1953:320, 1966:283; Schroeder 1979:250). The first permanent capital of New Mexico, San Gabriel de Yuque-Yunque, was established downstream from the reservoir area at the Tewa town of Yunque (LA 59) in A.D. 1600 (Schroeder 1984). Thereafter trading and raiding expeditions mounted by Native American and Hispanic groups commonly traversed the Rio Chama Valley; thus were generated a rich but dispersed ethnographic record of settlement and conflict in the form of military and commercial reports, church and civic government documents, and other letters (Wozniak 1987, Carrillo 1987a, Kemrer 1987, Kessell 1979). By A.D. 1730, Hispanic settlements were being established within the reservoir area (Swadesh 1974:33-35, 164), and local interaction with ethnically identifiable AmerIndian groups became a routine of life.

Modern research into the anthropology of the Rio Chama Medio began with the fascination of these documents for Adolph Bandelier who (1890-1892) attempted to identify the ruins of the villages described in early accounts, to characterize their archaeology, and to produce an ethnoarchaeology of the region by correlating archaeological data, historical accounts, and his own ethnographic observations. Similar approaches were employed by Hewett (1906), Jeancon (1911, 1923), and Harrington (1916).

Later workers, notably Mera (1934), Hibben (1937), Lambert (1944, 1946), and Wendorf (1953), concerned themselves with adding precision and detail to the culture history developed by earlier archaeologists. As Cordell (1979a, 1979b) emphasized, little or no literature is available to document most work carried out during this period; detailed published descriptions of excavations became a standard only after salvage work was stimulated by the construction of Abiquiu Reservoir (Peckham 1959, 1974). Much critically important work remains largely unpublished today. Most notably these works include Ellis's excavations at Sapawe, San Gabriel de Yuque-Yunque, Tsama, and Ghost Ranch (Skinner 1965; Ellis 1975, 1976).

The great bulk of well-published archaeological research in the Abiquiu Reservoir area was stimulated directly by the construction of the dam and reservoir and the resultant pressing need to salvage threatened cultural resources. Work was carried out (sequentially) by the School of American Research (SAR) (Schaafsma 1974, 1975a, 1975b, 1976, 1977, 1978a, 1978b, 1979; Beal 1980; Klager 1980), by the Division of Conservation Archaeology (DCA) (Powers and Swift 1980), by Nickens and Associates (Reed et al. 1982, Reed and Tucker 1983), by Chambers Consultants and Planners (CCP) (Lord and Cella 1986), and finally by MAI (this volume).

3.3 RESEARCH GOALS

Without exhaustive review of all documents and maps generated by mitigation efforts since 1974, it is impossible to summarize accurately the total known archaeological richness of Abiquiu Reservoir. Each successive survey or excavation team discovered that previously reported sites were wrongly located, incorrectly bounded or characterized, or simply not relocatable. The MAI field team also encountered prominent new sites in areas considered to have been exhaustively surveyed. However, data compiled by recent reviewers (Lord and Cella 1986) indicate that the SAR projects registered 362 sites and CCP registered two additional sites. The MAI-ACOE project registered seven new sites, implying a total reservoir area site count of 371 sites.

This last figure is deceptive. Had the detailed testing work not been clearly outside the scope of the present project, MAI field crews probably could have demonstrated the existence of continuous artifact distributions forming a supersite -- consisting of the MAI-ACOE project restudy sites LA 25330 and LA 25328, the new MAI-ACOE site LA 51698, and a noted but unrecorded site lying between LA 51698 and LA 25328. Similarly, the CCP-ACOE project contiguous new sites LA 47940 and LA 47491 (Lord and Cella 1986) together record a probably continuous artifactual scatter linking the MAI-ACOE restudy sites LA 25480 and LA 24742 across Comanche Canyon. These four sites are crossed by an old major wagon road which also crosses both an unreported but noted lithic site lying due east of LA 27042 and the extremely large LA 27018,

another MAI-ACOE restudy site. A fourth MAI-ACOE restudy site, LA 27020, probably links LA 25480 and LA 27018, while a CCP-ACOE restudy site, LA 27023, lies in Comanche Canyon almost equidistant between the unreported site and sites LA 27020, LA 25480, LA 47940, LA 47941, and LA 24042.

Sites LA 27023, LA 27020, LA 25480, LA 47940, LA 47941, and LA 24042 and the unreported site have been demonstrated to possess multiple components (Lord and Cella 1986) (see Chapter 7), and three of the seven were recorded by testing crews working in areas previously surveyed at least twice and thus presumably very well known. Further work at Abiquiu Reservoir would likely demonstrate the presence of many more as yet unreported sites.

Therefore, far fewer than 371 discrete archaeological sites probably exist at Abiquiu Reservoir. Simultaneously, there are certainly many more than 371 discrete occupations represented among the "sites" thus far known. It follows that chronological and technological generalizations developed in previous survey and excavation projects are, with few exceptions, suspect insofar as they presume unicomponency and culturally meaningful, clearly bounded sites. Full recognition of this problem's magnitude did not come until after emergency fieldwork was completed in June 1985. As a result, amended field data recovery procedures were not implemented to appropriately sample or record the essentially unbounded, nonsite palimpsest of Abiquiu Reservoir archaeology. Rather, laboratory procedures and research were modified to enable the study of suspected nonsite archaeological patterns using the data and materials already collected.

Special emphasis was consequently placed on studies which might advance the understanding of patterns of change in space and in time, which in turn might permit the technological, chronometric, or site-taphonomic disarticulation of palimpsest assemblages. These studies focused on:

- site-taphonomic dynamics and evidence of their action in disarticulating or otherwise modifying spatial patterns (e.g., the downhill study in Chapter 10);

- intensive study of subassemblages apparently resulting from a single articulated set of cultural acts based on material type and reduction sequence (Chapter 6), but shown to be multicomponent even when broken down into apparently discrete clusters (Chapters 7 and 9);

- chronometric evaluation of obsidian reduction sequence based on material type and other formal tool manufacture, reuse, and recycling and evaluation of natural and human modifications of debitage and nonformal tools (Chapters 7 and 8);

- typological assessment of the chronologically and typologically anomalous Archaic projectile point (Chapter 8) and historic ceramic (Chapter 11) assemblages reported from earlier studies (Lord and Cella 1986); and

- consideration of the impact of postdepositional phenomena on obsidian hydration rates in order to assess the value of hydration

analysis for absolute chronometry and for intrasite relative chronometry (Chapter 7).

4.0 FIELD METHODS

Jack B. Bertram

4.1 INTRODUCTION

Emergency archaeological field studies were carried out at Abiquiu Reservoir in May and June 1985, by MAI, under the field direction of Jack B. Bertram. Eleven previously described sites were studied, as were seven new sites.

4.2 FIELD STRATEGY AND SITE SELECTION

Due to the rapidly rising waters of Abiquiu Reservoir, the original ACOE scope of services was amended for the emergency field project. In close consultation with ACOE archaeologists, the Field Director advanced an acceptable alternative plan focusing effort on site clusters in the Comanche Canyon area. This area, essentially the northeastern upland section of the reservoir, was known to contain sites of unusual time depth and technological richness. Sites that were widely scattered with difficult access and/or already inundated (Table 4.1) were replaced with sites in this area to more efficiently use field time and to permit a thorough study of an apparent focal area of past occupation.

As it developed, the revised strategy was well-advised. The reservoir water level, which stood at 6244 feet above mean sea level at the field project's inception on May 25, 1985, had risen 12 feet to a new high of 6256 feet above mean sea level by the close of field activities three weeks later. Sites investigated early in the session were largely flooded by the end of field activities. One site (LA 27042) was cut off entirely, and the crew and equipment had to be ferried in canoes to complete the work.

The flooding of the reservoir's main boat ramp and support area by rising waters prompted the decision by ACOE to install a temporary boat ramp and car parks north of the Riana campground. MAI crews carried out survey and limited testing in these areas as well. Field study location procedures were abandoned. Instead, those areas facing direct impact were studied, and corridors of minimal impact were located and marked; as a result, only minimal effort could be invested in site boundary definition and in the selection of those areas best suited for scientific study.

Table 4.1 Scheduled Sites Not Investigated, MAI-ACOE Abiquiu Reservoir Emergency Project, 1985, Abiquiu Archaeological Study, ACOE, 1989.

Site Number	Justification for Deletion
LA 25344	Inspected twice by ACOE, Field Director, and crew (5-25-85 and 5-26-85). No site stake, features, or artifacts were located, although the site area was confidently located using large-scale orthophoto topographic map data.
LA 25345	Flooded; reported elevation from Nickens and Associates' field map was 6240-6242 feet.
LA 25351	Flooded; reported elevation from Nickens and Associates' field map was 6222-6237 feet.
LA 25370	Deletion suggested by ACOE; access difficulty.
LA 25421	Deletion suggested by ACOE; access difficulty.
LA 25426	Deletion suggested by ACOE; access difficulty; elevation of 6250-6253 feet. Map indicated site was flooded by third day of field session.
LA 25446	Relocation attempt by ACOE unsuccessful at reported site location; deletion suggested by ACOE in interest of efficiency.
LA 25448	Flooded when visited; Nickens and Associates' field map indicated elevation of 6235-6243 feet.
LA 25506	Flooded; Nickens and Associates' field map indicated elevation of 6240-6244 feet.
LA 25513	Flooded; Nickens and Associates' field map indicated elevation of 6235-6246 feet.
LA 25576	Flooded; Nickens and Associates' field map indicated elevation of 6236-6247 feet.
LA 27039	Deletion suggested by ACOE; access difficulty.

4.3 GENERAL FIELD PROCEDURES

General field procedures for previously recorded sites were as follows:

Surface collection:

- Each site was located and its boundaries reconnoitered. Special emphasis was placed on locating features and concentrations described by previous investigators; every effort was made to locate datum stakes from previous studies. Sites were considered bounded when no artifacts were encountered for a distance of 20 m.

- A permanent datum was installed using rebar with an attached aluminum tag; where initial site assessment suggested location of intensive collection or excavation units near previous datum stakes, these stakes were used.

- Horizontal control over surface materials was maintained using a moveable rope grid system (1 x 1 m control) referenced to the site datum and to appropriate temporary subdatum points. Isolates were plotted using compass and tape.

- All collection units were designated according to the distance in meters of their southwest corners from the main datum, which was assigned arbitrary, convenient horizontal and vertical coordinates.

- All artifact classes (e.g., ground stone, chipped stone, glass, metal, bone, etc.) from a given one m^2 unit were collected and bagged separately. All bags were labeled with site number, project number, collection unit name, date of collection, artifact class and count, and collector's initials. All diagnostic items were piece plotted, as were all collections from very sparse areas or sites.

Excavation collection:

- All excavated units were designated according to the southwest coordinate of the overlying surface collection grid system. Excavation proceeded in horizontal 10-cm arbitrary levels unless culturally meaningful, coherent strata were encountered.

- Excavated fill was screened through quadripod-slung 1/4-inch mesh screens; where appropriate and feasible, 1/8-inch mesh was placed under the 1/4-inch mesh so that 80-90 percent of materials were also passed through the finer mesh.

- All work was recorded. Color and black-and-white photographs were taken and logged; surface collection data were recorded in

the field on collection unit maps. These maps were prepared to permit crude, in-field density analysis and thermal feature detection as work progressed. All artifact collection bags were also recorded on field data inventory sheets by material, count, and provenience. A unique inventory lot number was assigned to every collection bag.

- Excavations were recorded on data forms; where features were encountered and tested, these were recorded on feature forms.

- Samples of soil, charcoal, and pollen matrix were collected from all cultural levels and, where appropriate, from noncultural levels.

- Excavation unit locations were chosen to examine areas of varying surface density and suspected features; test units were generally placed in high density areas, in low density areas where subsurface cultural deposits were suspected, or over areas of known or suspected features.

- In all cases where any subsurface soil or stratigraphic pattern or structure was encountered, plan and profile drawings were prepared and color-annotated as warranted.

- For those areas studied in the "boat ramp" portion of the project, similar procedures were followed, except that location of collection and excavation units was biased toward recordation in future impact areas.

5.0 LITHIC ARTIFACT ANALYSIS

Jeanne A. Schutt

5.1 ANALYTICAL VARIABLES

A total of approximately 27,000 lithic artifacts was recovered from 18 archaeological sites during the Abiquiu Reservoir project. The preponderance of lithic artifacts required a multistage research approach to facilitate addressing a variety of research questions. A rough sort was conducted on most lithic artifacts while a detailed lithic analysis was applied to 6,225 artifacts and aimed toward answering special questions discussed in the research design. The rough sort was to provide basic information on material acquisition, methods of tool production, and tool use. Variables pertaining to material selection and functional variability were examined spatially to aid in identifying horizontal proveniences across sites. This information was then used in identifying site type, function, and both intersite and intrasite variability.

5.1.1 Material Selection

The Abiquiu study area provides an especially rich assortment of high quality lithic raw materials. Pedernal chert and obsidians that originate in the Jemez Mountains are considered locally derived because of their relative proximity to the study area. Following Whatley and Rancier (1986:5-7-5-13), the local lithic resource base is defined as Jemez and Polvadera obsidians, Pedernal cherts and chalcedonies, and ancestral river deposits. These materials occur in three different kinds of deposits: 1) primary deposits immediately surrounding the primary outcrops, 2) secondary deposits of colluvial origin from the primary source, and 3) tertiary deposits in the Pleistocene terrace gravel deposits that dominate the Piedra Lumbre Valley. Jemez obsidians are defined in this study to include only materials in and adjacent to Valle Grande. Cerro del Medio obsidian occurs along San Antonio Creek at the northern and western edges of the caldera's interior and on and around Cerro del Medio at the eastern edge of the Valle Grande. Obsidian Ridge material is an extensive secondary deposit occurring along the eastern rim of the Valle Grande. Extensive deposits also occur near Rabbit Mountain and along the Sierra de Toledo. Polvadera obsidian primarily occurs in six outcrops along Polvadera Creek near Polvadera Peak. This material also appears to be available along the Canones Creek/Polvadera Creek corridor. Pedernal cherts and chalcedonies outcrop on Cerro Pedernal, near Upper Jarosa Canyon on the north slope of the Jemez Mountains, and at San Pedro Mountain near Gallina. The same materials can be found as secondary deposits near the present ground surface from Cerro Pedernal to Abiquiu Reservoir, concentrated near the villages of Canones, Coyote, and Youngsville. This material type also occurs in tertiary river deposits throughout the Abiquiu Reservoir area. Ancestral river deposits include fossiliferous cherts, petrified and silicified woods, quartzites (including Morrison quartzite), and indurated sandstones. These materials occur throughout the Abiquiu Reservoir area.

Nonlocal materials in this particular study are considered to be those that do not occur in the numerous gravels adjacent to the Abiquiu area. These include a Permian fossiliferous tan chert of nongravel origin and a vitrophyre basalt that appears to originate in the vicinity of San Antonio Mountain about 10 miles south of the Colorado border between the Rio Chama and the Rio Grande.

Abiquiu lithic assemblages often exhibit a high percentage of heat treated materials. Studies conducted by Whatley and Rancier (1986) indicate that the Pedernal cherts and chalcedonies used most frequently by inhabitants of the study area were frequently heat treated to facilitate formal tool manufacture. Whatley and Rancier (1986:5-17, 5-19) note that, because of the extreme hardness of many Pedernal chert and chalcedony deposits, heat treatment may often have been necessary to produce small formal tools. Heat treatment of siliceous materials alters the rock so that it is more vitreous, is more homogeneous, and possesses greater elasticity than similar, unaltered materials (Purdy and Brooks 1971). The technological advantages of heat treatment include a reduction in compressive strength and point tensile strength, allowing the production of larger flakes with less energy expenditure using either soft hammer or pressure techniques (Purdy 1982). Altered siliceous materials produce less shatter because of the reduction in internal flaws. Because the exposure to heat creates a more vitreous, glassy material through alteration of the crystalline structure, sharper edges can be obtained. Overall, workability of the material is increased, making tool production more energy efficient (Hicks 1986:6-27).

The CCP Abiquiu Reservoir debitage analysis (Hicks 1986:6-57) of well-dated assemblages found that assemblages from a Tewa pueblo occupied during the Rio Grande Classic Period exhibit more heat treatment than either earlier Late Archaic or later Piedra Lumbre assemblages. The analysis of 7,549 pieces of debitage from the CCP study also found that heat treatment, in conjunction with variables such as hard hammer percussion, platform preparation, multifacet or cortical platform, and utilization, distinguishes Pedernal chalcedony flakes from Pedernal chert, obsidian, and other material flakes (Hicks 1986:6-82).

Pedernal chert that has not been heat treated is suitable for large choppers, scrapers, axes, hoes, and other large tools, but less suitable for small formal tools such as projectile points. Replicative experiments using such Pedernal material have suggested that hard hammer instruments may be required during the early stages of reduction because soft hammer instruments are destroyed by the impact. When heat treatment was used to increase knappability, the material became much more amenable to soft hammer and pressure flaking techniques (Whatley and Rancier 1986:5-17, 5-19).

5.1.2 Reduction

Siliceous raw materials can be employed in the production of a wide range of potential tools that can either be used as specialized tools (projectile points) or be used to manufacture a variety of other less durable tools (e.g., tools made from bone, wood, reed, etc.). Because the lithic debris recovered from sites represents only a small window into the processes of tool

manufacture, use, and maintenance, it is important to maximize the information gained from lithic debitage.

Different types of chipped stone artifacts provide potential for answering varied questions about prehistoric subsistence. Formal tools, for example, may be curated artifacts that can be used to identify strategies of tool production and movement. Through examining the production of these tools, it is possible to better understand strategies of procurement, manufacture, and curation on an individual site basis. Conversely, waste flakes are a class of artifacts that for the most part remain in context providing an in situ record of past manufacturing and reduction events.

5.1.3 Functional Variability

The functional variability represented at a site provides keys to the past subsistence activities. Site functional variability can be identified by examining tool types and by examining the assemblage variability reflected in the debitage that is discarded at a site. This variability is generally identified by examining material selection, reduction, and evidence of tool use.

Tool use can be determined by examining overall artifact morphology and microscopic use wear. Microscopic use wear patterns (i.e., type and location of wear, orientation of striation, etc.) provide the most reliable evidence of use activities; however, many times tool use does not produce wear patterns that are identifiable using low power magnification. Tool morphology can be used to classify tools without microscopic examination. With information about the stage of reduction and the stage at which the tool was discarded, it is possible to isolate considerable data about activities that occurred on sites. The examination of tool morphology and microscopic use wear in conjunction with attributes of material type and reduction provides maximum potential for furthering the understanding of prehistoric subsistence.

5.2 METHODS OF ANALYSIS

Definitions used in this section are generally taken from Chapman and Schutt (1977) and Schutt (1982b, 1983a, 1983b). Any definitions from additional references are cited.

The attributes monitored during the rough sort and the detailed analysis are described below. The rough sort was designed to provide basic information about material selection, strategies of reduction, and site function, and provide a basis for identifying horizontal proveniences. The detailed analysis, however, was aimed toward providing information relating to more specific research questions, monitoring a comparative detailed sample from a number of sites in addition to providing data that was comparable to the rough sort.

The following section describes the attributes selected for the rough sort and the detailed analyses. Expanded variables and attributes that were characteristic of detailed analyses alone are described after the rough sort.

Attributes are defined and discussed in terms of the research questions previously outlined.

5.2.1 Rough Sort Material Type

Attributes monitored in the rough sort analysis were material type, heat treatment, artifact type, cortex, platform type, platform preparation/use, utilization, and marginal retouch.

5.2.1.1 Material Type

A four-digit material type code developed by Warren (1967) was used to identify raw material types and, when possible, potential sources of stone tools represented in the lithic assemblages. The lithic study conducted by CCP (Lord and Cella 1986) and additional data compiled by Whatley and Rancier (1986) indicate that Pedernal materials grade into a variety of colors and textures that may occur in the same nodule and therefore must be examined as a unit. Although Whatley (Whatley and Rancier 1986) argues that the white Pedernal cherts and chalcedonies are being selected from the gravels, while the gray and red materials are being acquired from the source, it was not possible to consistently classify chalcedonies which can occur in both varieties. Therefore, all Pedernal materials were lumped into one category (Table 5.1). All other materials were coded with the typology developed by Warren (1967) (see Table 5.1). A comparative type collection was developed from the Abiquiu lithic materials to aid in the consistent classification of raw materials. In cases where material type and potential source were unclear, Warren (1967) was consulted.

5.2.1.2 Heat Treatment

Heat treatment was monitored on all chipped stone artifacts. Heat treatment of siliceous materials is often revealed by a color change (frequently involving a reddening effect when iron is present in the stone), accompanied by a higher, glossier luster, and a smooth waxy feel. Different materials react to heat treatment in different ways depending on chemical composition and specifics of heat treatment, such as length of time and temperature of heating. Indications that an item has been heat treated may include higher luster on ventral surfaces than the original dull, matte exterior. Indications of possible unsuccessful heat treating or incidental burning may include crazing or calcining (a gray, powdery appearance resulting from significant loss of molecular water) (Hicks 1986:6-28). Facial retouch can destroy evidence of heat treatment. If heat treatment is identified, it may not be possible to determine if the item was treated as a core or as a flake.

Experiments conducted by Whatley and Rancier (1986) indicate that heat treatment can generally be identified by examining the luster of conchoidal surfaces on chipped stone. The rough sort analysis developed for MAI was aimed toward consistently identifying successful and unsuccessful heat treatment. Successfully heat treated specimens have a higher degree of luster and perhaps thermal discoloration whereas unsuccessfully heat treated specimens are marked by pot lidding scars, surface crazing, and jagged thermal

Table 5.1 Abiquiu Material Categories, Abiquiu Archaeological Study, ACOE, 1989.

PEDERNAL CHERT AND CHALCEDONY: Includes a number of cherts and chalcedonies; ranges from clear and white to gray and red; exhibits red and black specks and may have moss inclusions or milky white inclusions. This classification represents a broad range of Warren's (1967) codes that are known to occur in the same nodule (Whatley and Rancier 1986:Chapter 5:14). (Coded as 01. Materials include 1090, 1091, 1093, 1094, 1095, 1096, 1097, and 1099.)

CHERTS AND CHALCEDONIES:

MOSS JASPER: Yellow and red chalcedony; moss inclusions (moss jasper). Undifferentiated. (Materials include 1221, 1231, and 1235.)

BROWN JASPER: Yellow brown to olive brown chert (jasper). Undifferentiated. (Materials include 1070, 1073, and 1074.)

GRAY: Uniform gray, high luster. Undifferentiated. (Materials include 1600.)

GRAY MOTTLED: Gray mottled chert with high luster. Probably Morrison. (Materials include 1400.)

MOTTLED MORRISON: Red, gray, purplish mottled chert. Probably Morrison. (Materials include 1041 and 1042.)

NACIMIENTO: Clastic tan chert; grades to sedimentary quartzite. Nacimiento Formation. (Materials include 1021.)

MORRISON CLASTIC: Clastic; creamy white; grades to light green. Upper Morrison. (Materials include 1022.)

ALIBATES-LIKE: Resembles Alibates. Probably White Mesa, San Ysidro area. (Materials include 1413.)

UNDIFFERENTIATED BLACK: Black chert. Undifferentiated. (Materials include 1030.)

UNDIFFERENTIATED CHERT: Colors range from tan and buff to cream and olive. Probably Morrison. (Materials include 1630, 1650, and 1660.)

FOSSIL CHERT:

FOSSIL CREAM: Cream to light red. Fossils are minute circular inclusions, often with quartz crystals. Permian. (Materials include 1011 and 1012.)

Table 5.1 (Continued).

FOSSIL TAN: Tan chert similar to 1011 but appears to occur in separate nodules. Nongravel Permian origin. (Materials include 02.)

FOSSIL GRAY: Gray to tan chert. This code was used although the type does not represent the classic "fingerprint" chert. Permian. (Materials include 1016.)

FOSSIL BROWN: Brown mottled chert. (Materials include 06.)

SILICIFIED WOOD: Includes a range of colors; consistency ranges from dull to lustrous, with varying degrees of siliciousness. Undifferentiated; occurs in gravels. (Materials include 1112 and 1113.)

OBSIDIAN:

JEMEZ: Clear with brown tinges. Jemez Mountains. (Materials include 3520.)

POLVADERA: Smoky gray with fine white inclusions, black dust. Polvadera Peak. (Materials include 3530.)

QUARTZITE:

UNDIFFERENTIATED: Includes a range of colors. Probably El Rito Formation and common in gravels. (Materials include 4000-4014.)

QUARTZITIC SANDSTONE:

MORRISON: Colors range from light orange to red, tan, and gray. Probably Morrison Formation and gravels. (Materials include 2200, 2205, 2207, 2208, and 2209.)

ABO: Red, coarse to fine grain. Abo Formation. (Materials include 2206.)

BASALT:

VITROPHYRE: Black, dense, conchoidal fracture. Probably San Antonio Peak. (Materials include 3700 and 3400.)

UNDIFFERENTIATED: Gray. (Materials include 3050.)

RHYOLITE:

UNDIFFERENTIATED: Undifferentiated. (Materials include 3150.)

OTHER: Materials include sandstone (2015) and flagstone (2275).

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fractures. These variables were used to identify which materials were treated and to determine if differential heat treatment occurred.

5.2.1.3 Chipped Stone Tool Debitage Classification

Artifact types identified in the rough sort analysis include four classes of debitage (flakes, pot lids, angular debris, and cores) and formal and other tools.

Flake. A flake is a piece of debitage that exhibits a definable ventral and dorsal surface. The ventral surface is the surface that was last attached to the larger rock from which it was removed. Due to the tremendous volume of chipped stone debris and limited time for analysis, flakes were classified as biface flakes and core flakes on the basis of combined attributes, although discrete objective attributes would have been preferred. Biface and core flakes are examined statistically using attributes of platform morphology and size to determine if these classifications represent discrete manufacture techniques and reduction stage.

Biface Flakes. Biface flakes exhibit overall morphology indicating that they were removed from a bifacially flaked artifact during manufacture or resharpening. In this analysis a polythetic set of attributes described by Acklen et al. (1984:5-6) was used to define these flakes. Attributes that are generally characteristic of biface flakes include retouched platforms; lipped platforms; parallel, parallel and opposing, bidirectional, or multidirectional dorsal scars; overall concave flake curvature; flake thinness of 5 mm or less; even edge outline; and a weak bulb of percussion. Flakes were classified as tertiary if 60 percent of these attributes were represented.

Dorsal Cortex. Cortex is the outer covering on raw materials and represents geologic weathering through time. The amount of cortex on artifacts was used in conjunction with other attributes to identify stages and techniques of reduction. The following categories of cortex were monitored: 0) none, 1) 1-25 percent, 2) 26-50 percent, 3) 51-75 percent, 4) 76-99 percent, and 5) 100 percent. On flakes, cortex was measured as the percent of the dorsal surface. On small angular debris one surface was selected as ventral, and cortex was measured as the percent of the rest of the artifact. Percent of cortex on all other artifacts was measured as the percent of the entire artifact.

Platform Type. Platforms are the portion of a flake that is struck to remove the flake from a larger piece of material. Several types of platforms were monitored to aid in identifying reduction techniques, as well as methods of tool manufacture. Platform types included cortical, collapsed, single-facet, multifacet, retouched, and undetermined.

Cortical. Cortical platforms are striking surfaces that exhibit a portion of a remnant cortex surface.

Collapsed. Collapsed platforms result when the flake is removed from the core and the force of the blow eliminates the flat striking surface. Other than the lack of an actual striking surface, the proximal end of the flake is intact.

Single-Facet. A single-facet platform exhibits one smooth, noncortical surface that does not originate from an edge perimeter on the platform.

Multifacet. Multifacet platforms exhibit two or more noncortical facets that do not originate from an edge perimeter.

Retouched. This term is used to identify flakes that were removed from retouched tools. The platform is characterized by small, negative scars that originate on the platform from an edge perimeter. Flakes with these platforms are viewed as representing formal tool manufacture. Waste flakes are generally not curated and therefore provide reliable information about the location of formal tool manufacturing.

Platform Preparation/Use. When retouched platforms were identified, an attempt was made to monitor evidence of utilization and platform preparation to aid in distinguishing between resharpening and tool manufacturing activities. Although this distinction cannot be made on all flakes with retouched platforms, enough cases are clearly distinguishable. In the Kaiser Steel assemblage (KS 120) this distinction could be made on 36 percent of the flakes with retouched platforms (Schutt 1984). Grinding preparation on retouched platforms results in a flatter, less lustrous surface, while rounding resulting from utilization is not flat and is generally very lustrous.

Resharpening flakes generally occur where tools were resharpened. They represent a noncurated artifact that provides potential information about tool use as well as resharpening. By examining platform use and preparation one may be able to determine if a provenience represents purely a manufacturing area or an area where tools were used and discarded.

Uniface Flake. A uniface flake exhibits morphology indicating it was removed from a uniface during manufacture or resharpening a unifacial tool. Characteristics include parallel dorsal scars that originate from the single-facet platform; evidence on the platform of a uniform, functional edge (unlike a flake from a core); and a concave flake curvature.

During analysis a number of flakes were identified that exhibited retouched platforms and a single-facet dorsal surface. These flakes appear to be the reverse of the morphology expected when manufacturing or resharpening unifacial tools. It is unclear what aspect of reduction and manufacture is represented by these flakes. One possibility is that unifacial tools were transformed into bifacial tools; however, technological experiments must be conducted to reproduce this morphology and ultimately determine how production occurred. This type of flake was identified as a uniface flake with a retouched platform.

Core Flake. Flakes that were removed from cores exhibit overall flake morphology but are generally thicker than biface flakes and exhibit platforms that are cortical, single-faceted, or multifaceted. Core flakes can exhibit retouched platforms; however, platform dorsal angles are generally larger than those identified on biface flakes. Core flakes usually lack the convex curvature that is sometimes characteristic of biface flakes.

Unknown Flake. Flakes that could not be classified as biface flake or core flake were described as unknown flakes.

Pot Lid. Pot lids represent spalls that explode from the lithic material as the result of heat. They are viewed as representing the unsuccessful heating of raw material. They may represent a by-product of intentional heat treatment or may result from an occasional postdepositional fire.

Small Angular Debris. Small angular debris is a piece of debitage that weighs less than 40 grams and exhibits no definable ventral surface. It does exhibit conchoidal fracture indicative of percussion tool manufacture. Small angular debris is viewed as shatter or an unintentional by-product of reduction and tool manufacture.

Large Angular Debris. Large angular debris is an artifact that exhibits conchoidal fracture yet does not meet criteria for a core or a flake. It can be distinguished from small angular debris on the basis of weight; large angular debris weighs 40 grams or more. Large angular debris is viewed as a type of core material.

Cores. A number of core classifications were utilized in the analysis. Regular as well as exhausted cores were monitored. Regular cores are defined as pieces of debitage that exhibit negative scars, two or more centimeters in length that originate from one or more platforms. Regular cores are viewed as raw material that can still produce usable flakes. Exhausted cores are pieces of debitage that exhibit negative scars between one and two centimeters in length. These scars may originate from one or more platforms and can be distinguished from retouching on the basis of scar regularity along an edge margin. Where retouching is aimed toward producing a uniform edge for tool use, flake removal from cores is designed to produce flakes, resulting in more irregular edge margins. Exhausted cores represent the maximum use of raw materials.

Four subclasses of cores were identified among regular and exhausted cores. Core types include single-platform cores, multiplatform cores, bifacial cores, and tested cores.

Single-Platform Cores. Single-platform cores exhibit a single striking surface which serves as the platform for flake removal. Flake removal generally results in a core that is conical. Flakes that are removed from single-platform cores are similar in length suggesting a more systematic technique of core reduction than for multiplatform cores.

Multiplatform Cores. Multiplatform cores exhibit more than one striking platform from which any number of flakes are removed. Generally, flakes are removed from any usable platform, resulting in a random reduction technique that produces flakes of varied lengths.

Bifacial Cores. Bifacial cores are similar to bifaces in overall morphology; however, they exhibit steeper edge angles along edge perimeters and high centers. Flakes are removed from either surface adjoining the edge

margin by using the opposing surface as a striking platform. This core reduction technique results in an artifact similar to a biface but lacking evidence of bifacial thinning. Additionally, this technique produces not only flakes that can be used expediently or manufactured into formal tools but also a core that can easily be transformed into any one of a number of formal tools.

Tested Cores. Tested cores are pieces of raw material that were examined for material quality and rejected. Generally, one flake (but no more than two) is removed, and the core is discarded due to poor material quality. Tested cores represent initial stages of raw material selection.

5.2.1.4 Artifact Type - Formal Tools

The category of formal tools includes artifacts that exhibit either facial retouch or extensive marginal retouch. Facial retouch extends over one-third or more of the surface of the artifact. Extensive marginal retouch extends over less than one-third of the surface of the artifact yet alters the overall morphology. A cursory record of formal tools was kept during the rough sort and the detailed analysis. Formal tools were recorded in these analyses as uniface, biface, projectile point, drill, graver, and wedge. A specialized formal tool analysis was later conducted to distinguish between tools that were utilized then discarded (completed) and tools that were discarded prior to completion (incomplete). Methods used in this formal tool study are discussed after the detailed analyses methods.

Formal tools are curated artifacts that provide a great deal of information about tool use activities. Because they are curated, one must examine the reasons for their presence in various lithic assemblages. While waste flakes are a class of artifact that can be used to reliably indicate that reduction or manufacturing activities occurred at a site, the presence of formal tools does not necessarily indicate that formal tools were used at the location. One must examine overall tool morphology to determine if the tools were utilized and discarded or rejected prior to completion. Formal tools may represent manufacturing failures left at a manufacturing location. In this case successfully manufactured tools would be transported to another location for use. Before formal tools are used to assign functional variability, one must determine if tools were actually used at the location in question.

Biface. A biface is a formal tool that exhibits retouch extending over one-third or more of both surfaces of the artifact. Bifacially manufactured tools may include projectile points, preforms, drills, knives, etc. These tool categories are generally defined by overall morphology and evidence of use wear (see section 5.2.5 and Figures 5.1 and 5.2). Bifacial tool manufacture represents a formal type of tool production which requires a specialized manufacturing technology.

Projectile Point. Projectile points are generally produced through bifacial production; however, points manufactured on flakes with marginal retouch are not uncommon. Projectile point morphology is characterized by a point and two nearly bilaterally symmetrical sides that facilitate piercing. Bases were shaped to facilitate hafting.

Figure 5.1 Biface Stages: Blanks and Early Preforms, Abiquiu Archaeological Study, ACOE, 1989.

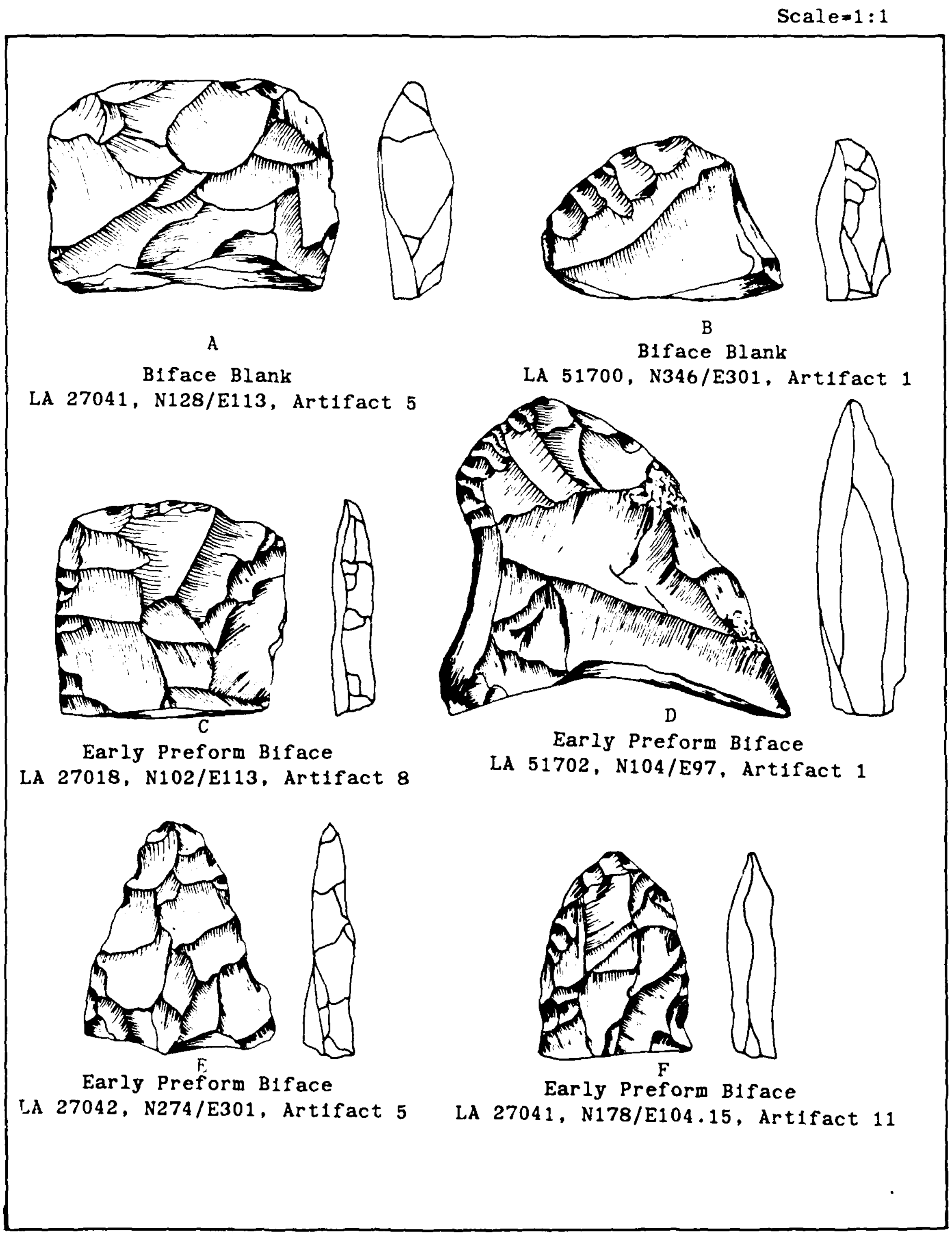
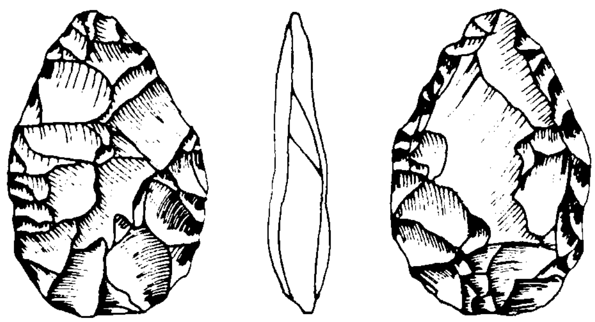


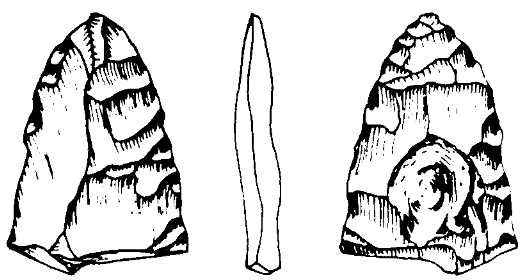
Figure 5.2 Biface Stages: Late Preforms and Tools, Abiquiu Archaeological Study, ACOE, 1989.

Scale=1:1



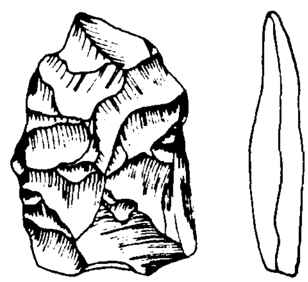
A

Late Preform Biface
LA 27018, N101/E128, Artifact 11



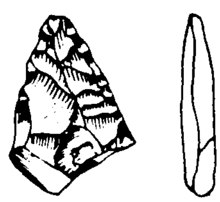
B

Late Preform Biface
LA 25328, N81.8/E104.1, Artifact 30



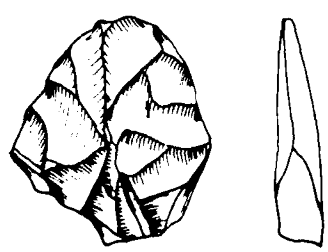
C

Late Preform Biface
LA 27004, N95/E120, Artifact 2



D

Biface Tool
LA 27041, N124.65/E112.92, Artifact 8



E

Biface Tool
LA 27041, N126/E112, Artifact 3
Complete

Projectile points were classified chronologically by Christopher Lintz (Chapter 8) and Jack Bertram (Chapters 6 and 7 and Appendix E.1). A discussion of projectile point chronology is provided in Chapter 8.

Drill. Drills exhibit bifacial retouch or extensive marginal retouch (Figure 5.3C and 5.3D). The retouching is aimed toward producing a projection and a handle. When wear patterns are present, rotary wear can be identified. Rotary wear is characterized by scarring or edge abrasion on the shaft of the projection and is produced as the tool is twisted in the drilling process. Striations are perpendicular to the shank orientation. The tip exhibits either crushing or rounding.

Graver. Gravers are also projections; however, unlike drills they do not require a long shaft (Figure 5.4A). Gravers are generally produced through marginal retouch and exhibit step fractures on the tip indicating that they were used in a scraping motion.

Wedge. Wedges exhibit bifacial retouch which forms a wedge shaped artifact. Battering occurs on both sides of the retouched edge suggesting that the wedge was driven into another object. Wedge-like tools prove productive in bone awl manufacturing (Schutt 1980:71). These tools need to be isolated in other assemblages and their associations with other in situ artifacts identified within activity areas. Only then can replicative experiments be used to reproduce use wear. Until that time, their function remains speculative.

5.2.1.5 Artifact Type - Hammerstones

Other tools are those featuring evidence of utilization but lacking evidence of formal manufacture. These are hammerstones and include knappers, peckers, and pounders. Hammerstones have been defined as artifacts that have been used as hammers. Generally, all rocks that exhibit evidence of battering have been categorized this way.

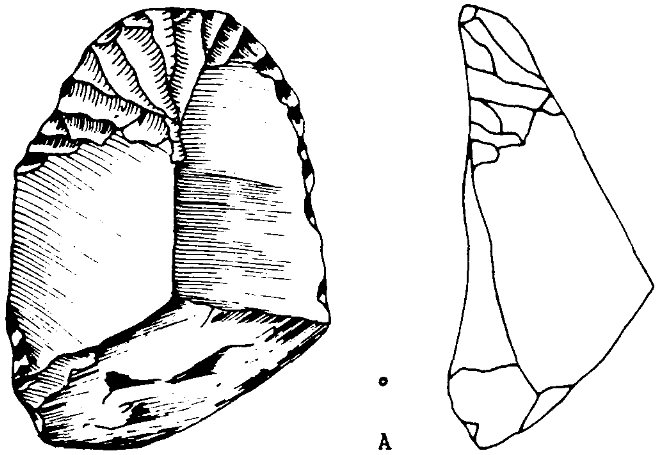
Hammerstone morphology indicates that a number of hammerstone types represent distinct activities (Schutt 1982b:161-166). Three basic hammerstone types are clearly indicated: knappers, ground stone sharpeners (peckers), and pounders. These three classes represent three different activities; however, it appears that there may be additional hammerstone types within these categories. It is important that ethnographic information as well as in situ artifact association be used to isolate the functional variability within these categories.

Knappers. Knappers are cobbles that exhibit battering on a localized portion of their smooth cortical surfaces. This type of battering is characteristic of use as a knapper or hammer for the manufacture of chipped stone artifacts.

Ground Stone Sharpeners (Peckers). Ground stone sharpeners are angular pieces of raw material or cores that exhibit battering on sharp edges. Their angular nature and the location of battering clearly do not represent use in chipped stone manufacture. Ground stone sharpeners may have been used to

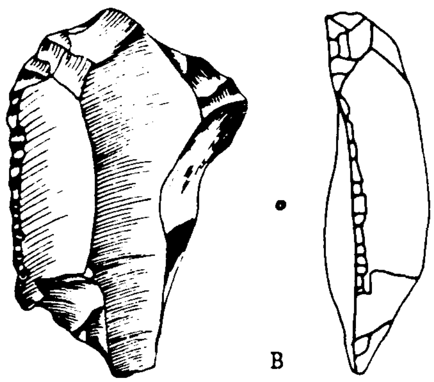
Figure 5.3 Marginally Retouched Flakes and Drills, Abiquiu Archaeological Study, ACOE, 1989.

Scale=1:1



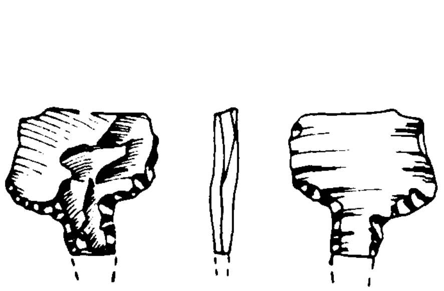
A

Extensively Unidirectionally Retouched Flake
LA 25328, N86/E118, Artifact 35
Complete



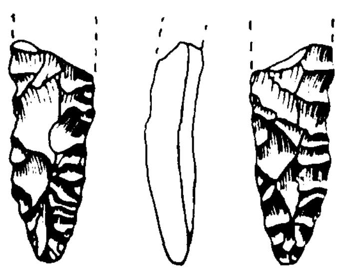
B

Extensively Unidirectionally Retouched Flake
LA 27020, N114/E129, Artifact 10
Complete



C

Drill
LA 25480, N393/E301, Artifact 2

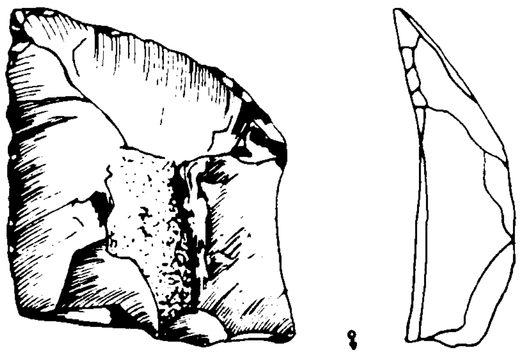


D

Drill
LA 25330, N120/E102, Artifact 7
Complete

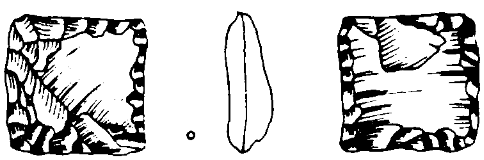
Figure 5.4 Graver and Gunflint, Abiquiu Archaeological Study, ACOE, 1989.

Scale=1:1



A

Graver
LA 51698, N101/E98, Artifact 9
Complete



B

Gunflint
LA 51698, N127/E135, Artifact 6
Complete

roughen grinding surfaces and have been known to occur in direct association with other grinding implements.

Pounders. Pounders exhibit massive battering which occurs on a convex surface. The battering is much more extensive than that identified on peckers and generally results in a uniformly smooth battered surface. This type of wear probably results from pounding another material against an anvil.

5.2.1.6 Utilization

During the rough sort, use wear was monitored macroscopically and therefore was identified in very low frequencies. Wear patterns were identified as unidirectional or bidirectional on the basis of direction of rounding and the proportion of scars on one side of the edge perimeter to the other side (Schutt 1982a). An edge with a 3.50:1 or greater ratio of scars on one side of the edge perimeter than the other side exhibits unidirectional wear. An edge with less than a 3.50:1 ratio exhibits bidirectional wear. Unidirectional wear is viewed as resulting from scraping activities while bidirectional wear results from cutting activities.

Expedient flake tools are generally a noncurated tool type. These tools are usually discarded in the location where use activities occurred, providing clear evidence of tool use.

In addition to edge damage, dorsal battering was recorded when identified. This wear is viewed as representing use that occurred prior to the flake's removal from a larger tool. Dorsal battering is characteristic of wear identified on ground stone sharpeners (peckers). Because dorsal battering on flakes is a by-product of ground stone resharpening, these flakes occur archaeologically where the use activity was carried out. In many cases the actual ground stone implements may no longer remain at the site (curated artifacts), but the flake with dorsal battering indicates that grinding activities probably occurred.

5.2.1.7 Marginal Retouch

Marginal retouch is the detachment of flakes from a tool's edge for the purpose of altering the shape of that edge. It is characterized as a series of negative scars that originate from an edge perimeter and extend over less than one-third of the surface of the artifact (Figure 5.3A and 5.3B). Unidirectional marginal retouch occurs on one surface of the artifact, while bidirectional retouch occurs on both surfaces which intersect at the edge perimeter.

5.2.2 Detailed Analysis

Attributes recorded in the detailed analysis were material type, heat treatment, portion, length, thickness, platform type, platform preparation/use, dorsal cortex, dorsal scars, utilization, and marginal retouch.

5.2.2.1 Material Type

Same as rough sort (section 5.2.1.1).

5.2.2.2 Heat Treatment

In addition to determining if heat treatment was successful or unsuccessful, during the detailed analysis an attempt was made to identify raw material forms (cores versus flakes) that were heat treated. When materials are treated as flakes, the dorsal and ventral surfaces of the flake exhibit thermal surfaces (Whatley personal communication 1986). As facial retouch proceeds, much of this surface is removed. Although in most cases retouching destroys evidence of heat treating raw materials as flakes, there are some cases where remnants of the thermal surface remain on both dorsal and ventral surfaces, clearly indicating that raw materials were heated as flakes.

5.2.2.3 Portion

Artifact portion was monitored as whole, proximal, distal, and medial when overall morphology allowed. In cases where proximal and distal fragments could not be identified, artifacts were recorded as unknown fragments.

5.2.2.4 Measurements

Length and thickness measurements were taken to the nearest millimeter on whole flakes and all other nonflake artifacts. Thickness was recorded on flake fragments. Length was measured along the proximal distal axes when possible (flakes, projectile points, etc.). In cases where proximal and distal could not be identified, length was the greatest measure on the artifact.

5.2.2.5 Platform Type

Expanded variables were used to monitor platforms during the detailed analysis. Cortical and collapsed platforms were defined as in the rough sort (section 5.2.1.3), while faceted and retouched platforms were recorded as single and multifaceted, unidirectionally and bidirectionally retouched. Single and multifaceted platforms were monitored to better identify techniques of reduction and manufacture. Unidirectionally and bidirectionally retouched platforms were recorded to aid in identifying unifacial and bifacial tool manufacture.

5.2.2.6 Platform Preparation/Use

Same as rough sort (section 5.2.1.3).

5.2.2.7 Dorsal Cortex

Same as rough sort (section 5.2.1.3).

5.2.2.8 Dorsal Scars

The dorsal surfaces of flakes were examined to identify scar counts and the direction of negative scars. Scar direction was monitored to aid in isolating techniques of core reduction and tool manufacture. The following dorsal scar categories were monitored: none, parallel longitudinal, parallel transverse, opposed longitudinal, opposed transverse, parallel and transverse, semiradial, random/varying, and indeterminate. These scar patterns are described below.

Parallel Longitudinal and Opposed. Parallel dorsal scars exist when the proximal/distal axes of flake scars are parallel to the proximal/distal axes of flakes. Parallel longitudinal scars are identified when two or more scars originate from the platform. Opposed longitudinal are also parallel scars, but they originate from the platform and distal ends. Parallel dorsal scars may represent systematic core reduction as well as bifacial tool manufacture.

Parallel and Transverse. Scar direction is from one of the lateral sides and one of the ends.

Parallel Transverse and Opposed. Parallel transverse scars are perpendicular to the proximal/distal axis of the flake, and scar direction is indicated from either the right lateral or left lateral portion of the flake (one side). Opposed transverse scar direction is from both the right and left lateral portions of the flake (two sides).

Semiradial. Negative scar direction is from three quadrants.

Random and Varying. Two or more dorsal scar directions are indicated. These scars do not exhibit any consistent pattern. Random and varying dorsal scars are viewed as representing a more random core reduction technique than the four techniques defined above.

None. When the dorsal surface of the flake exhibited cortex, it was identified as exhibiting no dorsal scar pattern.

Indeterminate. Dorsal scars were monitored as "indeterminate" when it was not possible to identify the direction from which flakes were removed.

5.2.2.9 Utilization

Artifacts were examined microscopically for evidence of use wear. A Swift binocular microscope was used to record unidirectional and bidirectional rounding and scars as well as hard and soft wear. Unidirectional and bidirectional wear was defined in the same way as described in the rough sort (section 5.2.1.6). Soft wear was distinguished from hard wear on the basis of rounding on the shoulders of the utilized edge margin. Experiments indicate that shoulder rounding results when a scraping edge is pushed against a soft, pliable media resulting in the lateral ends of the edge or shoulders being abraded (Schutt 1980:74). This shoulder rounding cannot be produced when scraping resistant materials.

The angles of utilized edges were monitored to aid in identifying additional functional variability among cutting and scraping tools. Utilized edge angles were measured to the nearest degree.

5.2.2.10 Marginal Retouch

Marginal retouch was monitored in the same way as described in the rough sort (section 5.2.1.7): unidirectional, bidirectional, extensive unidirectional, and extensive bidirectional. During the detailed analysis retouched edge angles were also measured to the nearest degree.

5.2.3 Cache Detailed Analysis

A suspected lithic cache was encountered during subsurface testing at LA 25328; analysis of its contents was somewhat different from other detailed analyses. The cache analysis was aimed toward identifying the technology used to manufacture flakes and to isolate the types of flakes that were not present in the reduction and manufacturing sequence represented in the cache.

The attributes monitored during this study were similar to those recorded for the detailed analysis (section 5.2.2). Attributes that were not identical to the detailed analysis are described below.

5.2.3.1 Portion

In addition to the portion attributes described in the detailed analysis (section 5.2.2), flakes with lateral splits were monitored to aid in characterizing flake production.

5.2.3.2 Measurements

Length, width, and thickness measurements were taken to aid in determining the types of flakes that were manufactured in the cache. Measurements were taken to the nearest millimeter. Length was measured from proximal to distal axes when possible. When the proximal or distal axes could not be identified, the largest measurement was considered the length. Width was measured at 90 degrees to the length, and the thickness was the perpendicular measurement of the third dimension.

5.2.3.3 Platform Angle

The platform dorsal angle was measured to the nearest degree to aid in identifying techniques of flake production. Flakes that were removed from single-platform and multiplatform cores should exhibit platform angles that are greater than platform angles on flakes that are removed from bifacial cores. Further, platform angles on flakes removed during formal tool manufacture should be more acute than those removed from cores.

5.2.3.4 Refits

The assemblage of flakes recovered from the cache was examined to determine if refits could be isolated. Refits were recorded as dorsal refit, ventral refit, dorsal and ventral refit, and refit at break or fracture. This attribute was monitored to provide information about technology as well as breakage patterns.

5.2.4 Downhill Detailed Analysis

The analysis of materials from the downhill transect at LA 27018 conformed to the detailed analysis, except in two areas. First, length, width, and thickness were recorded for all pieces examined, since the study was concerned with actual artifact size and shape, and not original or estimated whole artifact dimensions only. Second, dorsal and ventral abrasion was monitored to detect surface damage on artifacts which might be due to transport-related abrasion. All artifacts from the sample transect were examined under a 30-power binocular microscope for traces of abrasion or scratching on their dorsal and ventral surfaces. The following numerical code was used to classify abrasion in an essentially ordinal sequence: A 0 was coded for pieces with no abrasion; 1 was used for isolated scratches on ridges and projections but not flake scar troughs; 2 represented light abrasion on ridges and projections, isolated or no scratches on flake scar troughs; 3 signified moderate abrasion on ridges and projections, isolated to light abrasion on flake scar troughs; 4 meant heavy abrasion on ridges and projections, light to moderate abrasion on flake scar troughs; and 5 was used for heavy abrasion on ridges and projections and flake scar troughs.

5.2.5 Formal Tool Analysis

The formal tool analysis implemented for the Abiquiu Reservoir project was based on a number of studies aimed toward maximizing information about tool discard processes (Schutt 1983a), stages of formal tool manufacture, and tool use (Schutt 1983b). The formal tools that were examined in this study include bifacially and unifacially retouched artifacts and artifacts that exhibit extensive marginal retouch.

The formal tools that were recovered represent a variety of stages of manufacture and tool use. In the past many archaeologists have assumed that the formal tools recovered from sites represent tools that were utilized and discarded because they were no longer functionally useful. These discarded formal tools were interpreted as representing functional variability on sites and ultimately used to assign site type. A close examination of overall formal tool morphology indicates that many of these tools represent manufacturing failures which were never completed. These artifacts were either broken during manufacture or not completed due to flaws in the material or reduction process. Generally, these artifacts occur in the location of manufacture and provide excellent information on the location and type of tool manufacture that occurred but little information about tool use activities.

Artifacts that were used and discarded represent functional variability. Although microwear analyses can be used to indicate that a tool has been

utilized, the difficulty in identifying use wear on retouched tools limits the usefulness of such analyses (Odell 1975, Keeley 1974, Schutt 1980). In many cases utilized tools can be identified on the basis of completed morphology. Tools that are utilized and discarded because they are no longer functionally useful generally occur in areas where use activities were carried out and therefore provide excellent information about site structure and functional variability. The distinction between complete and incomplete formal tools is critical to interpretations of archaeological sites. Without this distinction areas with a number of manufacturing failures are potentially classified as use locations when they actually represent manufacturing locations.

The identification of complete and incomplete formal tools can be made on the basis of a number of attributes, and by monitoring angle variability along functional edges. Artifacts can be classified by examining overall symmetry as well as characteristics of manufacture and raw material.

Artifacts that have been manufactured as tools exhibit functional edges. The characteristics of these edges are conditioned by the activities for which they are manufactured. An example is the difference between a functional edge that was made to cut versus scrape. These functional edges represent distinctly different morphology, yet exhibit a consistent functional edge shape within each class. The functional requirements of the cutting tool are a fairly uniform edge that is sharp. This edge can be straight (knife) or serrated (saw), but it must be uniform and form a straight line in plan view if it is to perform the activity prescribed. The same is true of the scraping tool. The functional requirements again are a uniform edge that in plan view produces a straight line. The activity of scraping, however, requires an edge that is not sharp and will withstand the force necessary for scraping activities. Both tools exhibit uniform, straight use edges that in plan view form a consistent line. This consistency is a functional requirement of the edge and can be identified within any class of complete tool.

Artifacts that are incomplete lack straight, functional edges. Until final stages of manufacture, bifacial artifacts may exhibit uniform edges, but in plan view edges appear sinuous and do not form a straight line. Incomplete artifacts may possess edge angles useful as expedient tools, however. This sinuosity is necessary to bifacially thin the artifact. Not until later stages of manufacture is this sinuosity reduced to form the final functional edge. Again, these requirements may include a variety of edge shapes but always an edge that is manufactured to form a functional edge that is uniform and produces a linear area to contact the medium being worked.

In addition to attributes of overall symmetry, it is possible to identify flaws in manufacturing and raw material that result in tools being discarded before they are complete. Manufacturing error may result in a tool that cannot be bifacially thinned due to a high spot resulting from flakes that terminate in a step rather than feather out as intended. Flaws in the raw material can result in breakage. Raw material and manufacturing flaws are easily identified.

Complete and incomplete tools are classified on the basis of a combination of the attributes defined above. Although subjective, this distinction

can be made fairly quickly and reliably by a trained lithic specialist. The subjective technique was used by the author in the present study.

Studies indicate that functional edge angles can be used to objectively classify complete and incomplete tools (Schutt 1983b). Although more time consuming, this method not only results in a statistically reliable classification but can also be implemented by less experienced technicians. The range of angle variability along functional edges is used to determine if tools are complete or incomplete. Studies previously conducted by the author (Schutt 1983a, 1983b) indicate that the range of edge angle variability on complete tools is less than that identified on incomplete tools. Edges with a range of angles greater than 15 degrees were consistently those previously designated subjectively as functionally incomplete, while those with a range of edge angles less than 15 degrees were the ones subjectively defined as functionally complete (Schutt 1983a:210). Edge angle is a necessary but not sufficient criterion for classifying tool completeness. Presence of basal grinding, notching, and use wear are additional attributes of complete tools.

In addition to completeness, formal tools were classified to indicate their type and stage of manufacture. These data were recorded to aid in identifying function on the basis of completed tool morphology and to determine the stages of tool manufacture represented among incomplete tools. Artifact types included bifaces, unifaces, projectile points, drills, perforators, gravers, end scrapers, and artifacts with extensive marginal retouch. Bifaces represented a number of manufacturing stages which include incomplete artifacts (blanks, early bifaces, late bifaces) and complete tools (bifacial tools). The biface typology was adapted from the Rhodes Canyon report (Schutt 1983b) and is discussed in section 5.2.6. Classifications of artifact type and stage of reduction were used in conjunction with evidence of heat treatment to identify strategies of heat treatment used to produce a variety of formal tools.

5.2.6 Attributes Monitored

The attribute analysis was conducted in two stages. Artifacts were classified into type and described as complete or incomplete by the author. All other attributes were monitored by a technician. The following attributes were recorded.

Material. Material type was monitored in the same way as described for other lithic analyses (see section 5.2.1.1).

Heat Treatment. Heat treatment was monitored in the same way as described in the detailed analysis (see section 5.2.1.2).

Haft Width. Haft width was measured in millimeters as the broadest measurement where projectile points were attached.

Portion. Formal tools were examined to define the portion of the artifact found in relation to the original whole artifact. Categories included whole, undetermined fragment, basal fragment, tip, midsection, lateral portion, and basal snap. A basal snap was recorded to distinguish

between a basal portion of a projectile point that can include a large portion above the hafting element and a basal snap which is broken at the haft and generally represents an impact fracture.

Tool Type. The tool types identified in this study include biface, uniface, projectile point, drill, perforator, graver, end scraper, thumb nail scraper, and artifacts with extensive unidirectional or bidirectional retouch. The majority of scraping tools was classified as finished unifaces (Figure 5.5). Scrapers were classified only when classic tool types were identified (end scraper and thumb nail scraper; Figure 5.6). Artifacts with extensive marginal retouch were examined because they represent a class of tool that exhibits extensive time investment in overall flake modification.

Projectile points were classified as finished or incomplete. Projectile point and chronological assessments assigned by Bertram (Chapter 7 and Appendix E.1) are used in Chapter 6.

Stage of Bifacial Manufacture. The stage of bifacial manufacture was monitored to aid in determining processes of reduction and manufacture as well as identify strategies of heat treatment. Four biface types were identified, and the typology was largely taken from the Rhodes Canyon report (Schutt 1983b). Biface types include blank, early biface, late biface, and bifacial tool. Blanks represent early stages of bifacial manufacture. These artifacts are rough preforms that can be used for the manufacture of any number of artifacts (Figure 5.1A and 5.1B). Early bifaces (Figure 5.1C - 5.1F) generally exhibit beginning stages of bifacial thinning and exhibit edges that are irregular both laterally and transversely. They are manufactured from direct percussion and are larger than completed tools (Crabtree 1972). Late bifaces (Figure 5.2A-5.2C) are bifacially thin and generally exhibit well-shaped edge morphology. They may evidence pressure flaking, but their overall morphology remains incomplete. These artifacts are generally broken in final stages of manufacture. Bifacial tools (Figure 5.2D and 5.2E) are bifacially thin and exhibit uniform functional edges that can be produced by direct percussion but generally exhibit uniform evidence of pressure flaking. Overall morphology indicates that the tool is complete.

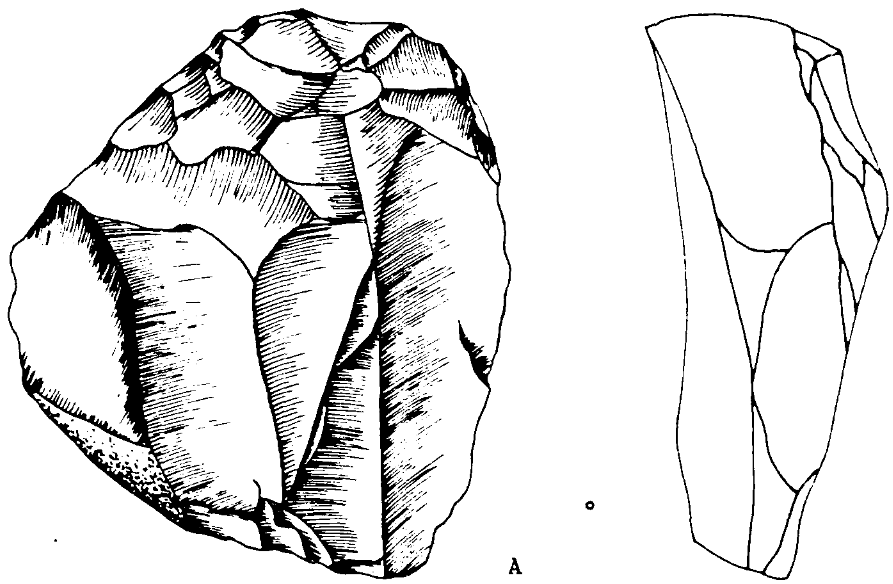
Completeness. Formal tools were examined to determine if they were complete prior to discard or if they represent manufacturing failures (incomplete). Artifacts were recorded as complete, incomplete, or undetermined. Artifacts were classified as undetermined whenever there was doubt concerning completeness.

Utilization. Completed artifacts were examined for evidence of micro-use wear. Time did not allow the examination of incomplete artifacts for evidence of secondary wear.

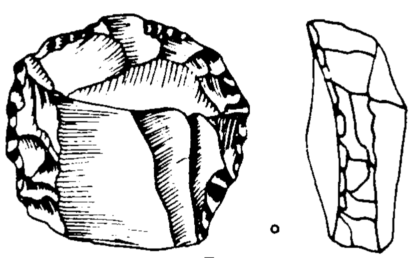
Reworking (Modification/Resharpening). Formal tools were examined for evidence of reworking. Obsidian hydration dates presented in the CCP report (Lord and Cella 1986) indicate that early projectile points were scavenged and reworked by later inhabitants of the area. Tools were examined for differences in hydration and patination as well as gross morphological characteristics indicating that reworking occurred.

Figure 5.5 Unifaces, Abiquiu Archaeological Study, ACOE, 1989.

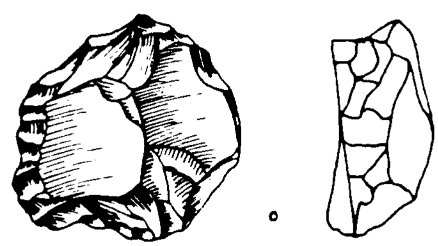
Scale=1:1



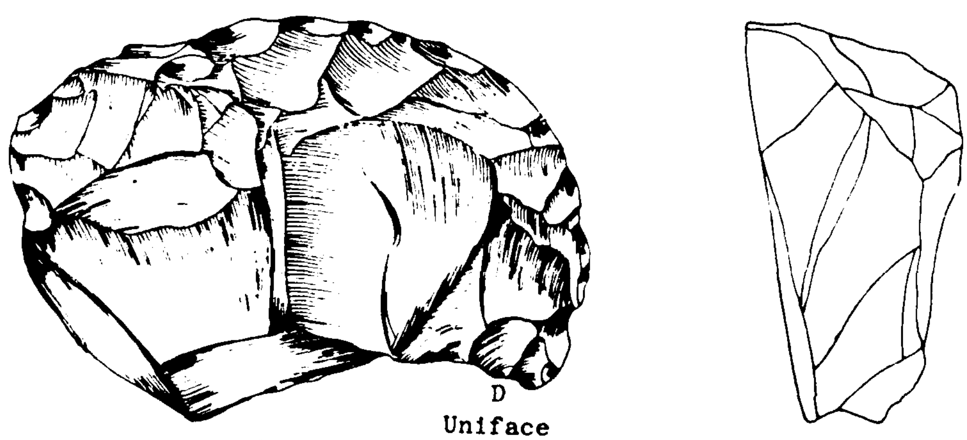
A
Uniface
LA 25330, N109.26/E108.51, Artifact 20
Complete



B
Uniface
LA 27020, N114/E110, Artifact 2
Complete



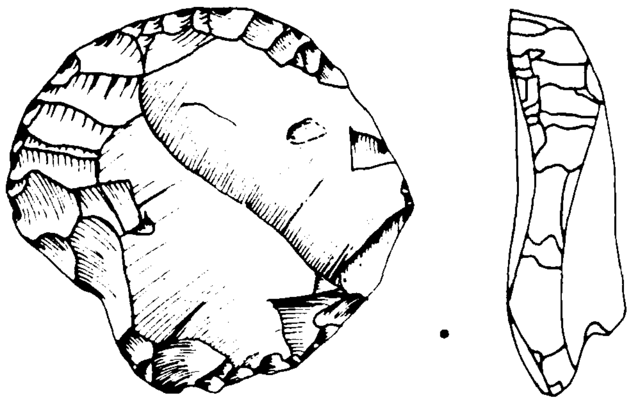
C
Uniface
LA 51703, N103/E102, Artifact 10
Incomplete



D
Uniface
LA 25333, N113/E116, Artifact 3
Incomplete

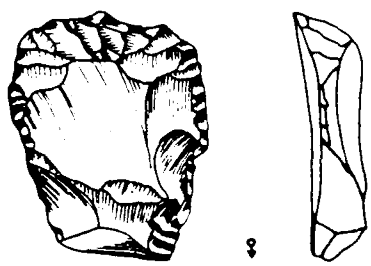
Figure 5.6 Scrapers, Abiquiu Archaeological Study, ACOE, 1989.

Scale=1:1



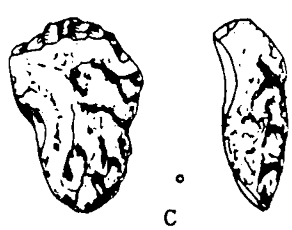
A

Scraper
LA 25330, N109.59/E109.14, Artifact 19
Complete



B

Scraper
LA 25330, N111.47/E116.85, Artifact 21
Complete



C

Thumbnail Scraper
LA 27004, N98/E106, Artifact 8
Complete

PART II

SITE DESCRIPTIONS

6.0 SITE DESCRIPTIONS

Jeanne A. Schutt, Steven Kuhn, Janette Elyea,
Jack B. Bertram, and Amy C. Earls

The 18 sites studied in the course of the MAI-ACOE Abiquiu Reservoir testing project fall into five spatial clusters. The first of these lies on the Llano Piedra Lumbre to the north of Comanche Canyon; it includes sites LA 25328, LA 25330, LA 25333, and LA 51698 (Figure 6.1). The second group of sites lies athwart Comanche Canyon; it includes LA 25480, LA 27018, LA 27020, LA 27041, and LA 27042 (Figures 6.2 and 6.3). The third group lies slightly south, near Arroyo del Chamiso; it is composed of LA 27002 and LA 27004 (Figure 6.4). The fourth group, composed almost entirely of new sites encountered during survey for a temporary road, boat ramp, and car park, lies south of Arroyo de Comales (Figure 6.5); it is composed of LA 25532, LA 51700, LA 51701, LA 51702, LA 51703, and LA 51704. The last group contains only site LA 51699, which overlooks La Canada del Chama immediately upstream from Abiquiu Dam (Figure 6.6).

The following site descriptions are presented in order of site cluster. First, a summary is presented characterizing the site's setting, previous work, and field procedures and observations. This is followed by analytical characterization and interpretation of the data recovered by MAI archaeologists for that site. The descriptions of site setting, previous work, field methods, surface collection units, and subsurface samples and stratigraphy are based on the field data summaries; these were written by Janette Elyea, Steve Kuhn, and Jack Bertram. The lithic analysis summaries which follow were written by Steven Kuhn (LA 25328, LA 27018, and LA 51701) and Jeanne A. Schutt (all other sites).

The lithic analysis summaries are organized in the following manner. The analytical format focuses on delineating homogeneity or variability in lithic material type selection, heat treatment, reduction trajectory, use wear, and function within the sites treated. Many of the spatially distinct subassemblages were thought to relate to temporal differences; Chapter 7 gives an obsidian hydration based perspective on this temporal variability within sites. Chapter 8 provides additional chronological information from obsidian recycling, radiocarbon, projectile points, and ceramics and synthesizes chronological evidence for the 18 sites. Chapter 9 discusses lithic assemblage characteristics in terms of a cluster analysis of significant variables for all sites with adequate samples and lithic distributions in terms of a spatial analysis of densities of various artifact types on two sites, LA 27002 and LA 25480. Site occupational histories and intersite comparisons are provided in Chapter 12.

Tables accompanying the site descriptions include a listing of flotation, pollen, and C-14 samples by provenience where applicable. Artifact types, lithic material types, and heat treatment are presented in tabular form for sites with sufficient variability to warrant such treatment. Summary tables of heat treatment, material selection, and reduction are given in section

Figure 6.1 Llano Piedra Lumbre Site Cluster, Abiquiu Archaeological Study, ACOE, 1989.

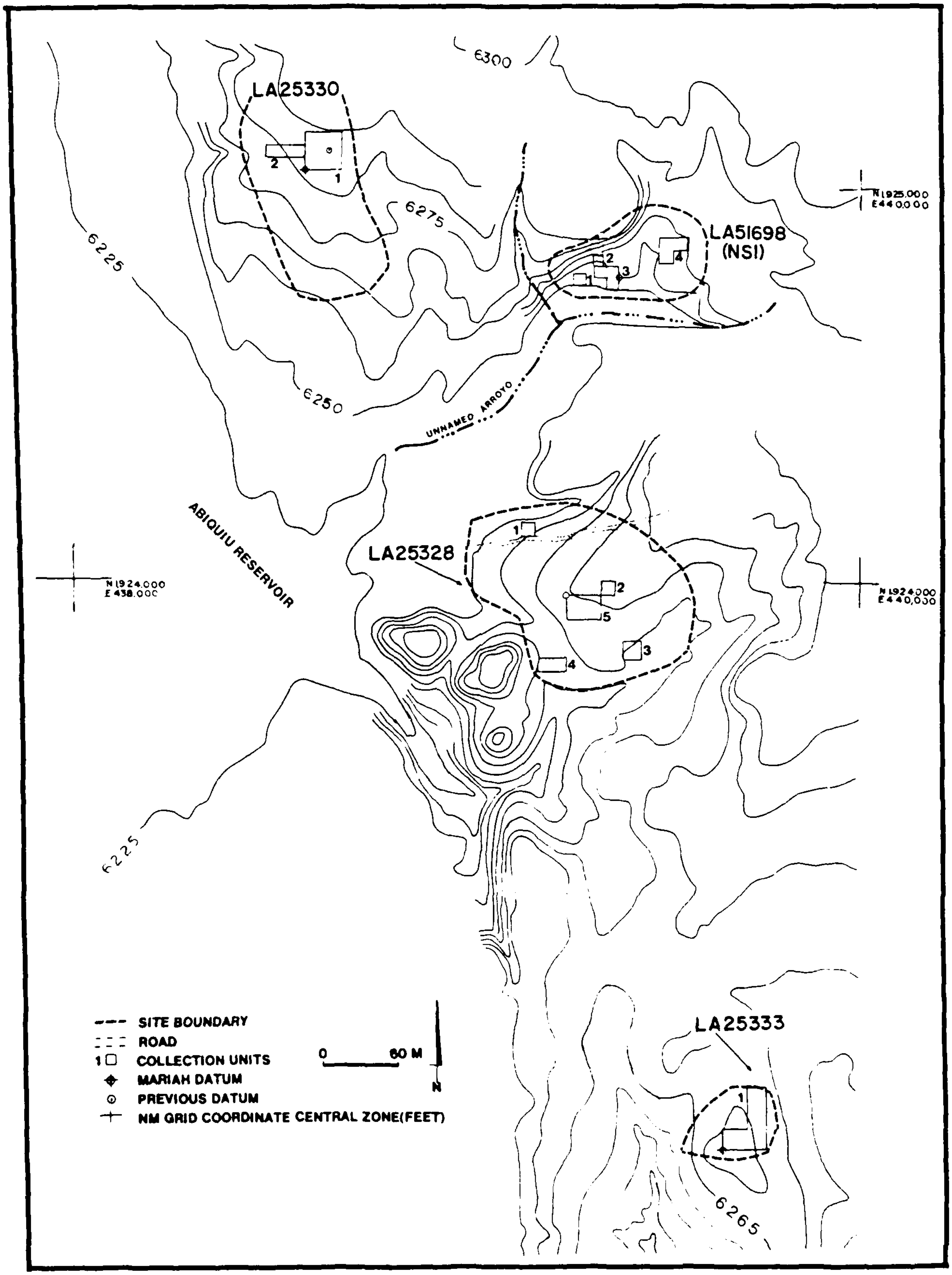


Figure 6.2 North Comanche Canyon Site Cluster, Abiquiu Archaeological Study, ACOE, 1989.

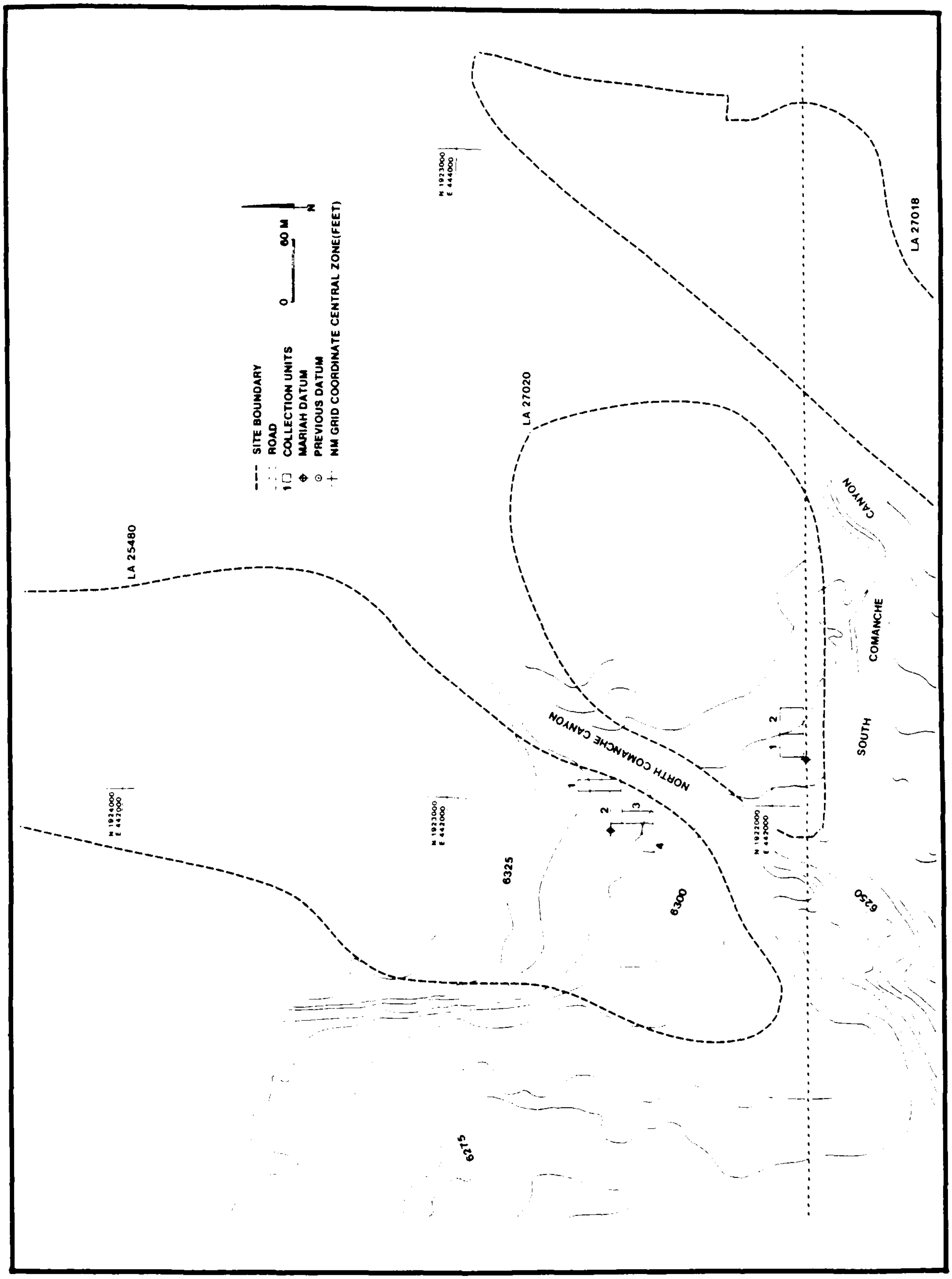


Figure 6.3 South Comanche Canyon Site Cluster, Abiquiu Archaeological Study, ACOE, 1989.

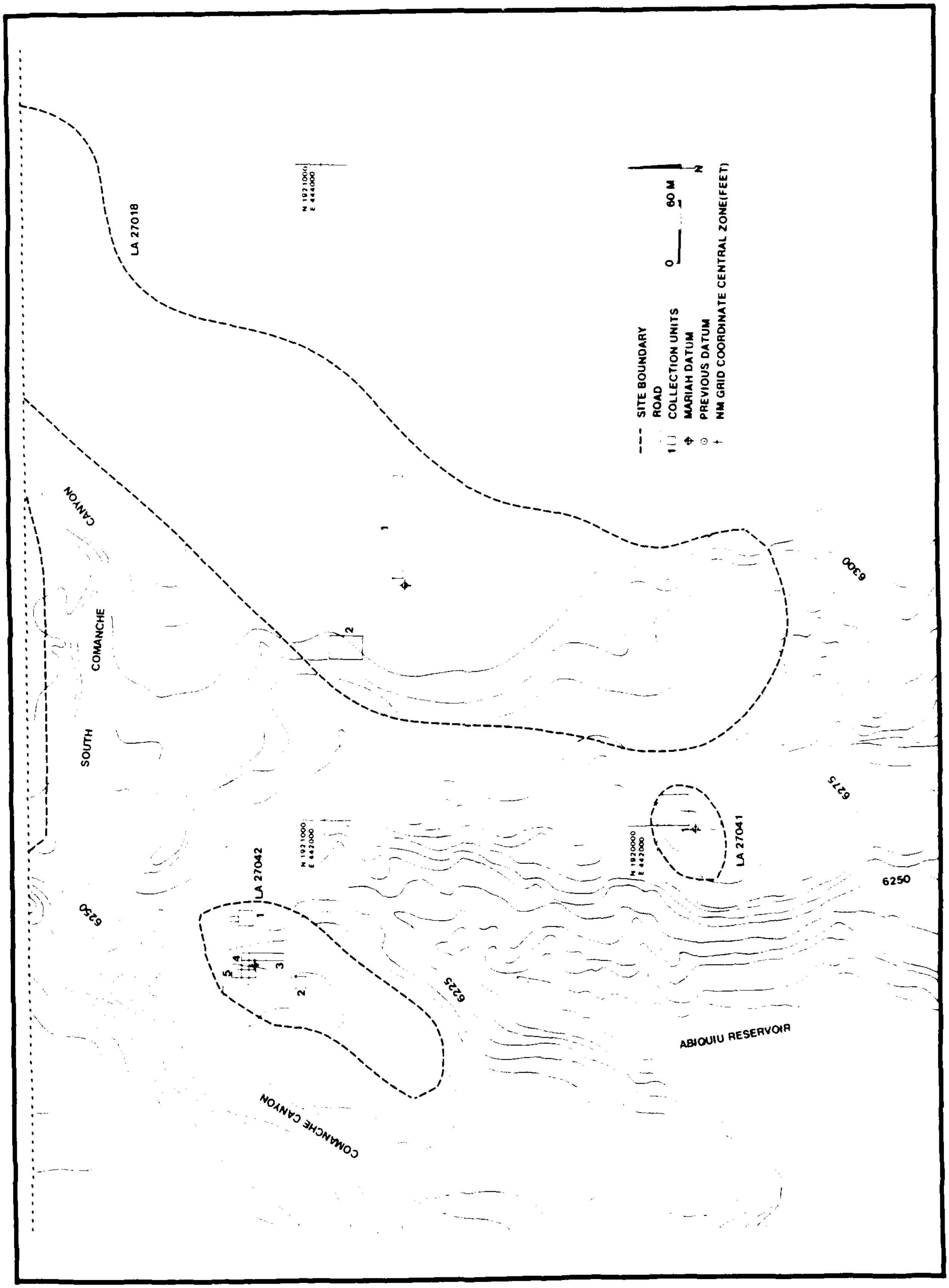


Figure 6.4 Arroyo del Chamiso Site Cluster, Abiquiu Archaeological Study, ACOE, 1989.

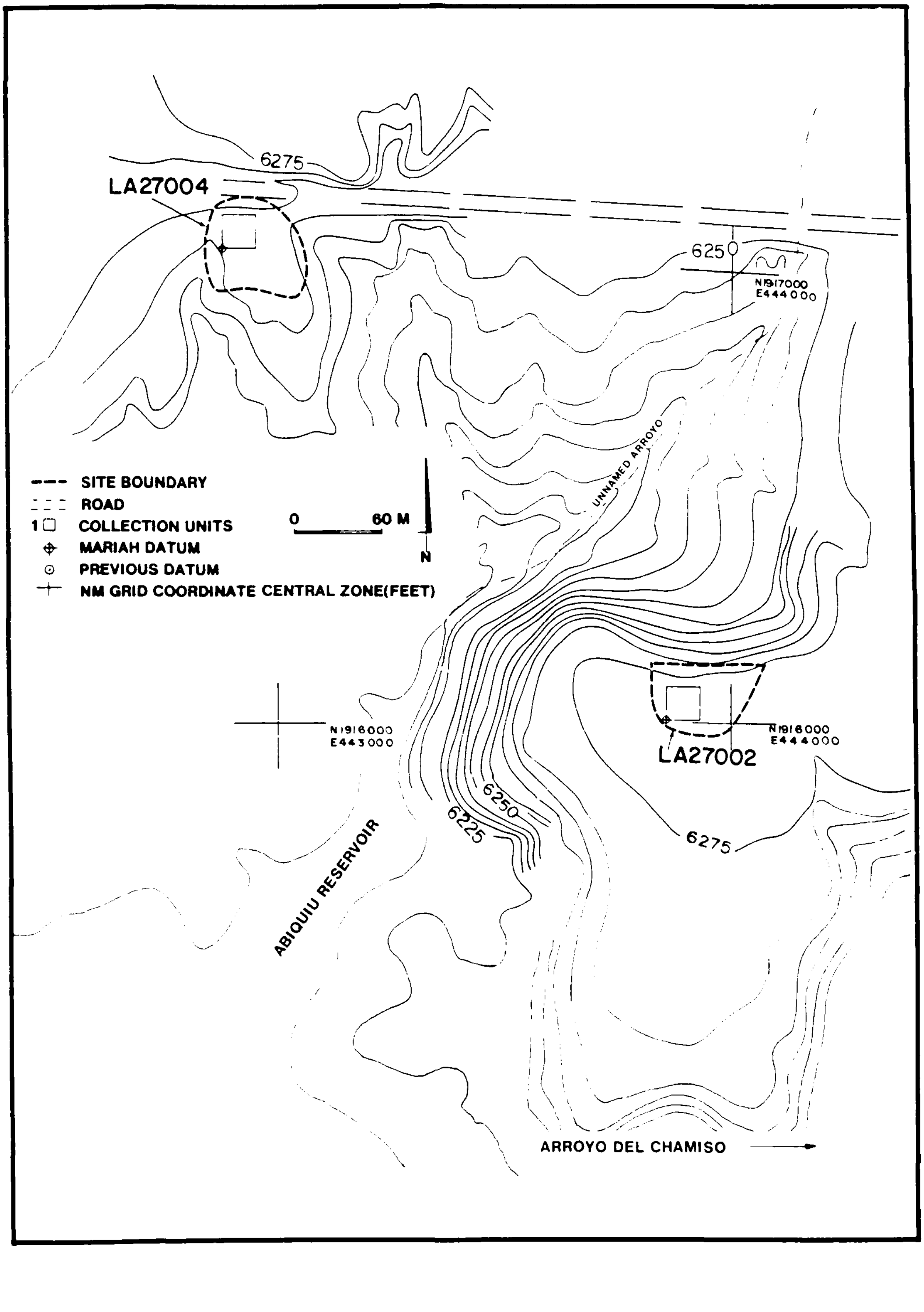


Figure 6.5 Arroyo de Comales Site Cluster, Abiquiu Archaeological Study, ACOE, 1989.

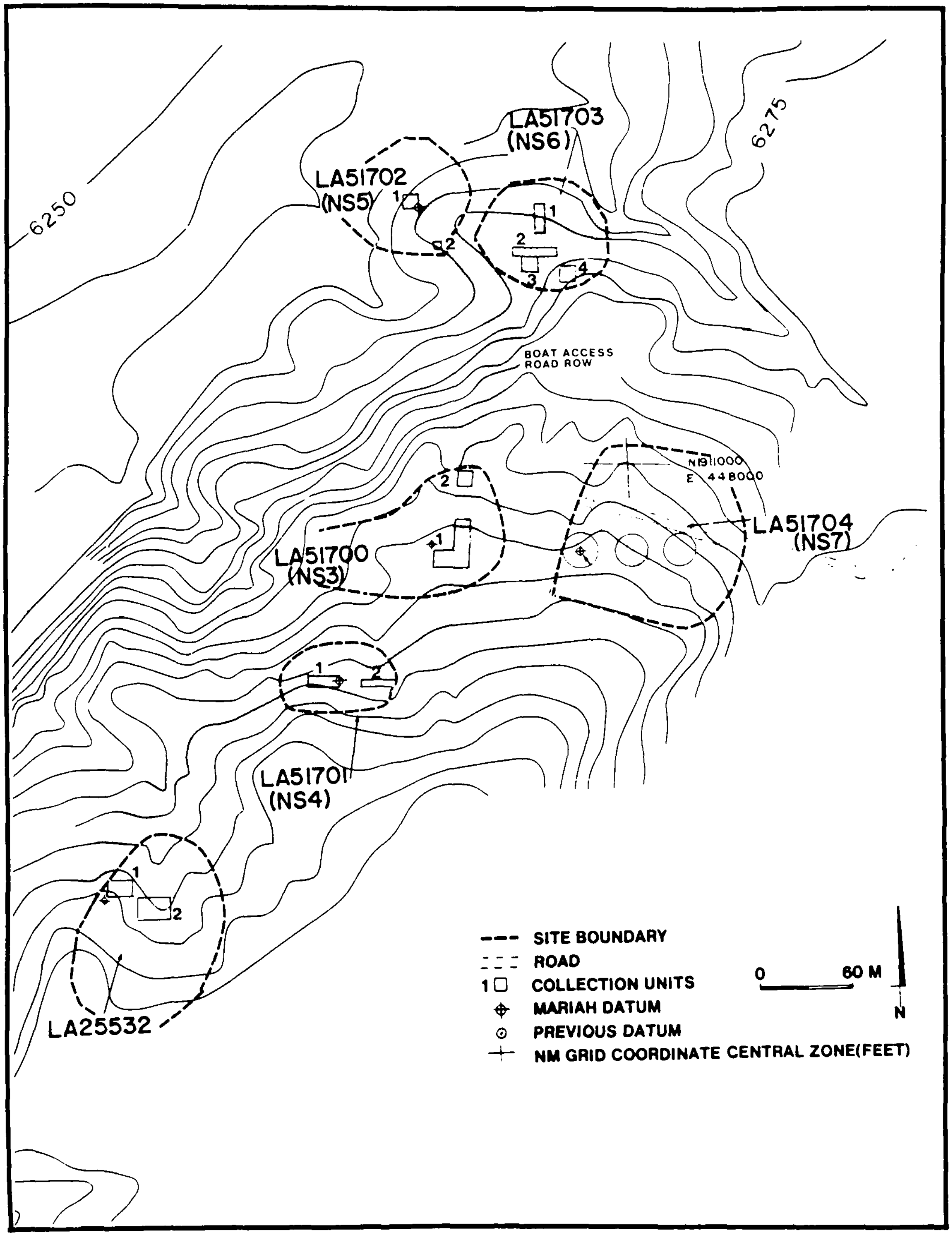
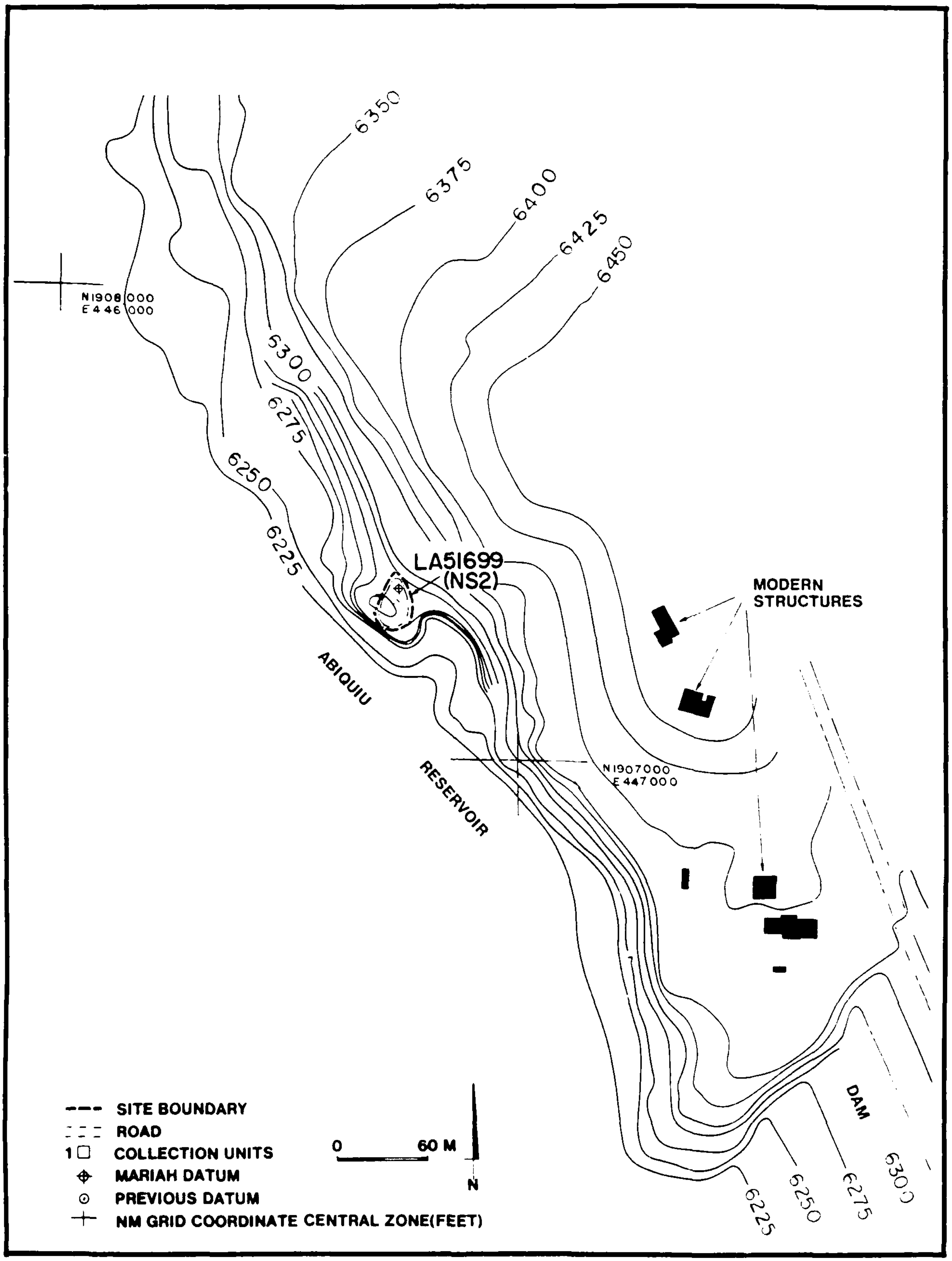


Figure 6.6 Canada de Chama Site, Abiquiu Archaeological Study, ACOE, 1989.



6.20. Text and table totals do not always correspond since miscellaneous categories are not always listed in the text discussion.

Illustrations include site cluster maps, site detail maps, and plans and profiles. The site cluster maps depict spatial relationships among nearby sites and topography. Site detail maps show both surface collection units and test pits. In each site description, plan view and cross section drawings are included for structural features. Profiles are given for each test pit when the stratigraphy is discussed.

Section 6.2.7.8 (Provenience 12) discusses the lithic cache in LA 25328. This specialized study describes monitored portion, metric dimensions, platform angle, and refit attributes (see Chapter 5) to enable characterization of flake production, flake type, and breakage patterns. The results demonstrate clearly how the cache materials differ from the remainder of the site lithic assemblage and represent an important contribution to knowledge of caching behavior.

6.1 SPATIAL ANALYSIS METHODS

Baseline analyses of patterning in the surface distributions of artifacts were carried out for all of the Abiquiu sites. These studies were undertaken to identify spatially distinct concentrations of either single or mixed raw material types which could then serve as units of analysis and comparison in studies of lithic materials from each site. It was intended that the results of more intensive artifact analyses would be used to address questions relating to the functional, chronological, or noncultural processes responsible for the formation of differential density clusters within the individual sites. The investigations address specific questions relating to downslope movement of artifacts and the distributional integrity of spatial clusters of artifacts within the site.

The methods for the basic spatial pattern recognition were relatively simple. Cross-tabulated surface density maps were generated for each discrete surface collection area at each site and visually inspected for discrete high density clusters. A threshold level of five artifacts per standard 1-m^2 surface collection grid was used to identify high density grids at most sites. The only exception to this rule was in surface collection Units 3 and 5 at LA 25328, where extremely high surface densities (up to 76 artifacts/m^2) were encountered. In these two instances, a high-low density threshold of 12-15 artifacts/m^2 was used. Pedernal cherts were the dominant raw material in the lithic assemblages at all of the sites included in this study. Where other materials made up over five percent of the total assemblage or where such materials were present in frequencies of greater than 20-25 specimens, separate distributional maps were produced for each important material type and inspected for high density grids. Density cutoffs were adjusted in response to the relative frequencies of the less common materials. Raw material was chosen as the second variable in the recognition of spatial clustering because spatially distinct concentrations of debitage of a single distinctive raw material are the most expedient criteria for identifying reduction events or other fine-grained components within a surface palimpsest.

Once high density surface units were identified, these were grouped into more or less rectangular subunits which were treated as distinct proveniences or subassemblages in the assemblage-level analyses and comparisons. The use of rectangular subunits rather than grid-by-grid designation of high density areas was a concession to the exigencies of computerized data processing. However, the inclusion of a few low density grids in a high density subprovenience is not likely to bias the assemblage structure or content significantly, due to the fact that the extra units yielded few artifacts. A flexible set of criteria was used to determine whether or not a given spatial concentration was defined as a separate provenience unit for analytical purposes. To minimize the effects of stochastic recovery biases and small-scale topographic and vegetative variability, concentrations were identified as distinct proveniences only if 1) they contained a sufficient number of artifacts to minimize potential sample bias effects in comparison with subassemblages from other areas of the site and 2) they were sufficiently distinct in both content and density from surrounding surface areas. Portions of surface scatters most closely associated with features such as hearths and structures were also delineated as distinct proveniences on the basis of general artifact density contours.

The results of comparisons of assemblage content and structure between spatially discrete artifact clusters and areas of variable density are described in sections reporting individual sites.

6.2 LA 25328

6.2.1 Physiographic Setting

LA 25328 is an extensive, moderate to extremely dense lithic scatter situated on a ridge top knoll and relatively flat bench to the south of a small, deeply incised arroyo. The site is located on the Llano Piedra Lumbre on the eastern slope of the Chama River Valley between 6255 and 6265 feet in elevation, approximately 1,700 m east of the old river channel. Elevations across the site surface decrease to the west and south, and at the time of this investigation, large portions of the reported western and southern areas of LA 25328 were already submerged by the rising waters of Abiquiu Lake. The level central portion of the site is covered by relatively deep, stable, light colored, sandy soils. The northwestern and western portions of the site, in contrast, are severely eroded, and large areas of sandstone and shale bedrock are exposed. Areas of rapidly eroding soil are also found to the immediate southwest of the site stake, and toward the southeastern margin of the site, especially in and around surface collection Unit 4. Site vegetation is pinyon-juniper and grassland. An old, partially graded road runs from west to east across the northern part of the site.

6.2.2 Previous Work

LA 25328 was first discovered by SAR survey crews and was described as a "heavy lithic concentration" (Schaafsma 1976) containing a variety of lithic materials and covering an area of approximately 15,000 m^2. Revisitation by Nickens and Associates in 1982 (Reed et al. 1982:21-22, 57-58) confirmed these general observations. Charcoal was encountered in a test unit excavated by

Nickens' crews, but no architectural features or hearths were observed on the surface.

6.2.3 Field Methods

A total of 1,105 m^2 of the surface of LA 25328 was subjected to 100 percent surface collection. Although this represented a relatively small proportion of the total area of the scatter, the extremely high surface densities encountered in some areas were considered to have provided an adequate sample. A total of five 1 x 1 m test units was excavated. For convenience of description, surface units have been given number designations 1 through 5 on the site map (Figure 6.7).

6.2.4 Surface Collection Units

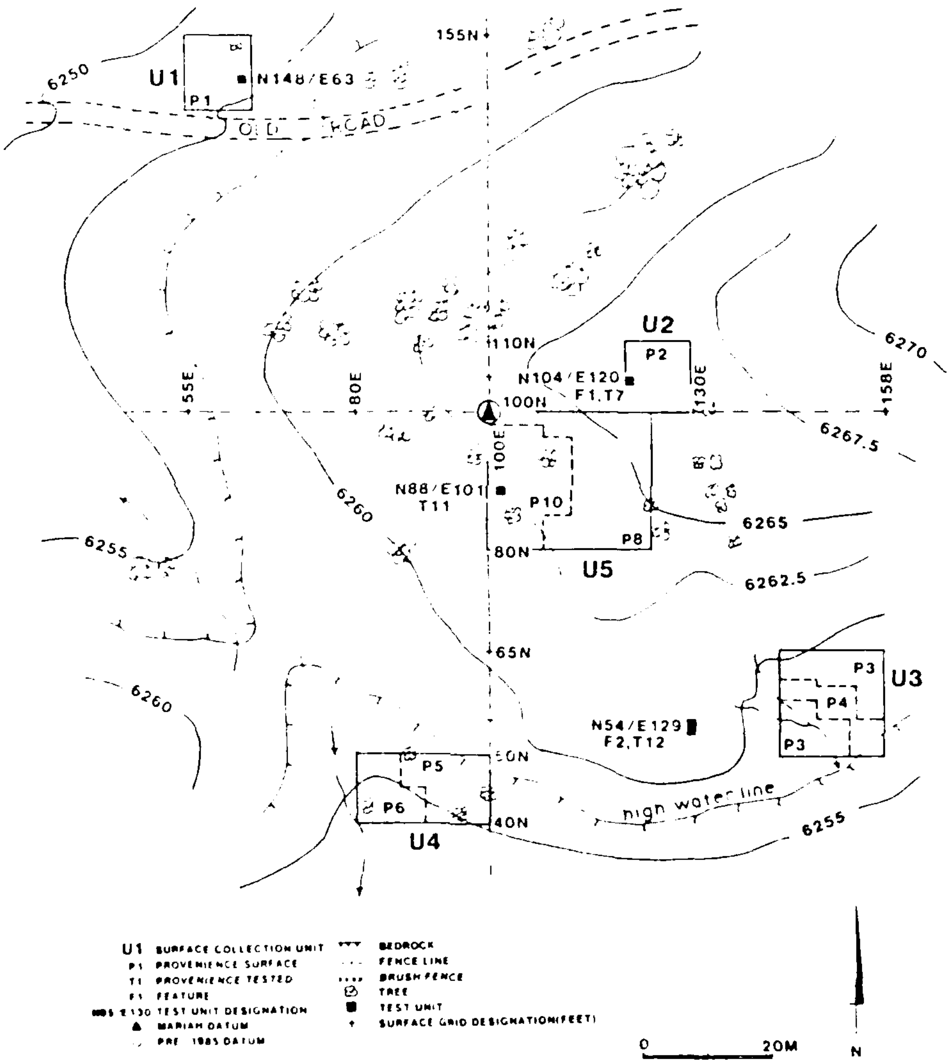
In general, surface units were placed to sample areas of the site exhibiting short-range changes in surface density and depositional regime (e.g., stable soils abutting eroding soils). Unit 1 (10 x 10 m) was placed in an area with relatively low artifact density and almost no soil; a large proportion of the squares collected consisted entirely of exposed bedrock, which nonetheless yielded artifacts. Unit 2 (10 x 10 m) was similarly located in a low density area, but one which had apparently stable, relatively thick, sandy soils. Units 3 and 4 (15 x 15 m and 10 x 20 m, respectively) were intended to sample relatively dense surface concentrations separated from the main concentration (around the site stake) by low density areas. The soil in Unit 4 seemed to be actively eroding. Soil cover in Unit 3 appeared somewhat more stable although numerous cobbles and small boulders of materials similar to local bedrock were exposed on the surface. Unit 5 (24 x 20 m) was placed near the center of the densest part of the surface concentration, where soils appeared more or less stable, except near the head of a small drainage which had its origin in the southwestern corner of the block.

A total of 8,772 artifacts was recovered from the surface at LA 25328, and an additional 1,300 were collected from excavation units. Field inventory sheets list only three pieces of ground stone; the remaining artifacts are all chipped stone. A large number of projectile points and fragments and an even larger number of biface fragments were collected. The distribution of these materials based on field impressions is discussed below.

In spite of the presence of bedrock over a large portion of its surface, collection Unit 1 yielded moderately high numbers of artifacts. A total of 273 specimens (2.73 artifacts/m^2) was recovered from this block, and surface densities ranged from a low of zero to a high of 12 artifacts/m^2. This block yielded a higher proportion of obsidian (0.16/m^2) artifacts than the other block (5) with substantial obsidian (0.11/m^2).

Perhaps due to less deflation, Unit 2 was the least productive surface block. Only 66 artifacts (0.66 artifact/m^2) were recovered, primarily from the southeastern portion of the unit. The least productive portions of this block were covered with a somewhat thicker mantle of light colored, aeolian sand.

Figure 6.7 LA 25328, Abiquiu Archaeological Study, ACOE, 1989.



Unit 3 yielded a total of 1,517 artifacts (6.74 artifacts/m^2), including numerous bifaces and fragments. Surface densities ranged from zero to 38 artifacts/m^2. The highest surface densities were encountered in the portion of the block with lowest elevation in an oval distribution oriented north-west-southwest, located within a small drainage channel. It appears likely that the horizontal structure of surface deposits in Unit 3 has been modified considerably by erosional movement of artifacts.

Block 4 sampled an isolated concentration on the rocky crest of a small finger of the terrace on which LA 25328 is located. In all, 1,187 artifacts were collected from this 10 x 20 m block (5.9 artifacts/m^2). The highest surface densities were encountered in the western portion of the block which was rapidly being inundated as surface collection was taking place. Densities as high as 30 artifacts/m^2 were encountered.

As expected, collection Unit 5 exhibited the highest surface densities at LA 25328 (11.87 artifacts/m^2). A total of over 5,700 artifacts was collected. The highest densities, ranging up to 103 items/m^2, were recorded in the western two-thirds of the area. The eastern third of Unit 5, in contrast, exhibited very low surface densities comparable to those of the adjacent areas in Unit 2. Numerous bifaces and fragments, as well as several large cores and a hammerstone, were collected from the high density areas within Unit 5.

6.2.5 Subsurface Samples and Stratigraphy

Three of the test units (grid designations 88N/101E, 148N/63E, and 104N/120E) were selected to test for subsurface or buried deposits within surface collection blocks. Two adjacent test units (53-54N/129E) were placed within a small, isolated surface lithic concentration which appeared to represent a possible chipping feature. This concentration consists of materials representing core reduction and tool manufacture and is discussed in Section 6.2.7.8. Table 6.1 lists samples taken from the site.

Table 6.1 LA 25328 Samples, Abiquiu Archaeological Study, ACOE, 1989.

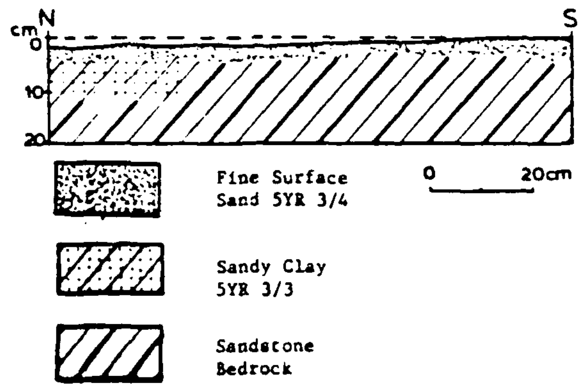
Provenience	Flotation	Pollen	C-14
N53-54/E129			
Feature 1, Level 1	1	1[1]	--
Feature 1, Level 2	1	1	--
N88/E101, Level 2	1	1	--
N104/E120, Level 2	1	1	--

[1] See Appendix D for results.

Test unit 148N/63E (Figure 6.8), located within collection Unit 1, was screened through 1/4-inch mesh and yielded two obsidian flakes. Bedrock was

encountered at a depth of 2 to 10 cm below ground surface, and fill appeared to consist largely of decaying sandstone bedrock.

Figure 6.8 LA 25328, N148/E63, Level 1, East Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



Unit 104N/120E was located within collection block 2 in order to check for buried deposits beneath apparently recent stabilized aeolian sands. Materials were screened through 1/4-inch mesh. Only one flake was recovered, but the remains of a possible hearth feature were found. This feature consisted of a 12-cm diameter patch of darkened, possibly charcoal-stained soil which was located beneath several large rocks at a depth of approximately 18 cm below ground surface (Figure 6.9). Scattered flecks of charcoal were also noted throughout the overlying fill. Field notes suggest that the bulk of the feature must either have been located in the adjacent square or have been eroded away. Excavation was discontinued at a depth of 20 cm or less, when decaying shale bedrock was encountered (Figure 6.10). The lack of depth in this portion of the site was surprising, in light of surface impressions.

Grid 88N/101E was excavated in an area of extremely high surface density within the main concentration. All fill was screened through 1/8-inch hardware cloth. Two hundred and sixty lithic artifacts and a complete burned one-hand mano were found in the first two levels, along with a number of burned sandstone fragments. The greatest density of artifacts occurred in the first 10-cm level. No ash or charcoal was encountered. A compact, calichified sandy layer encountered at a depth of approximately 8 cm below ground surface appeared to represent the lower limit of the artifact distribution (Figure 6.11).

Test units 53N/129E (Figure 6.12) and 54N/129E were placed in an area with a high surface density of large flakes, thought to represent a possible

Figure 6.9 LA 25238, N104/E120, Level 2, Plan View, Abiquiu Archaeological Study, ACOE, 1989.

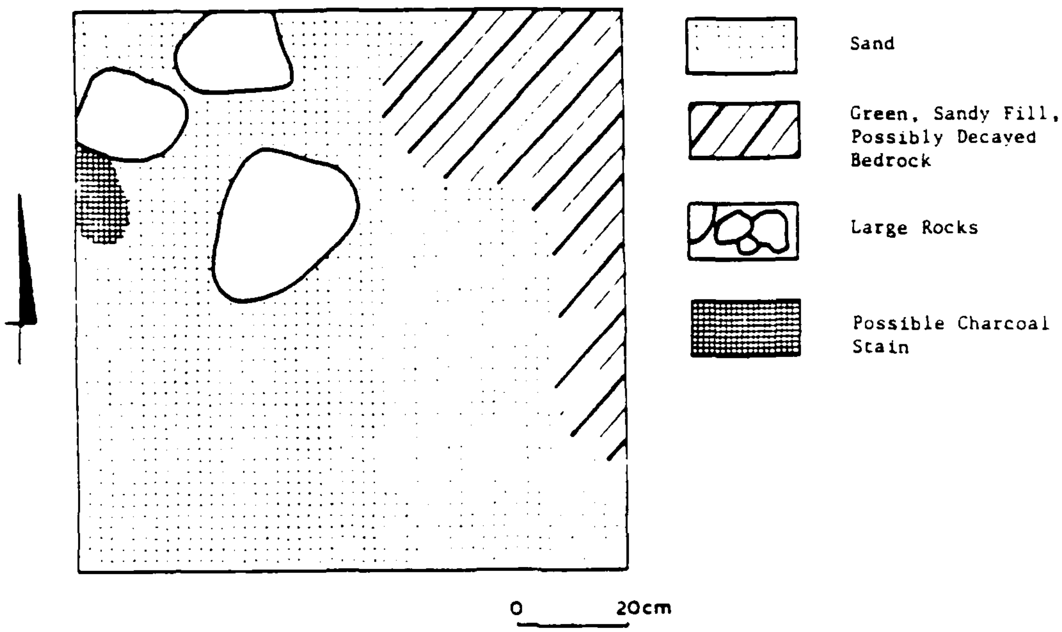


Figure 6.10 LA 25328, N104/E120, North Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

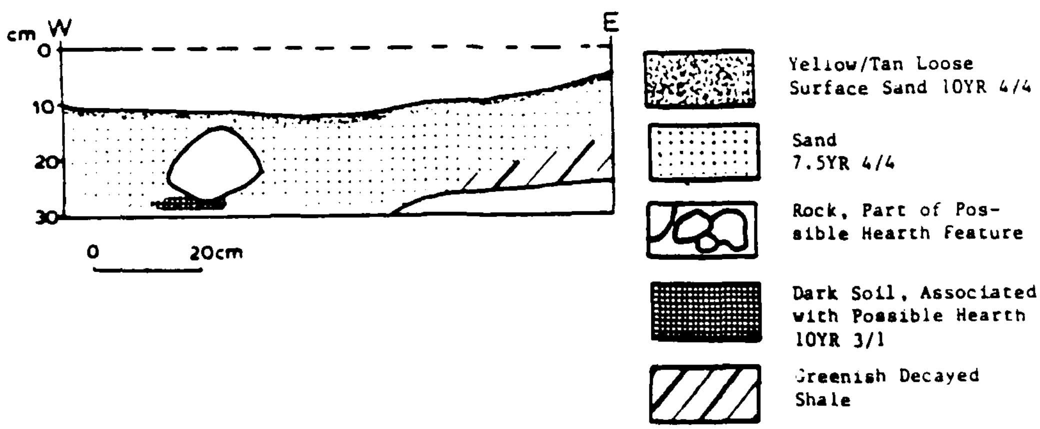


Figure 6.11 LA 25328, N88/E101, Base of Level 2, East Wall Profile, Abiquiu Archaeological Study, 1989.

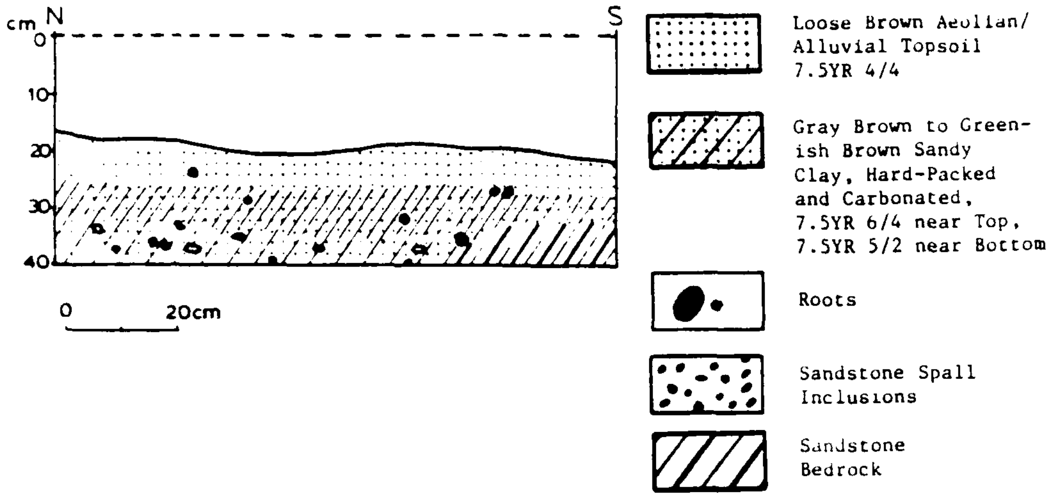
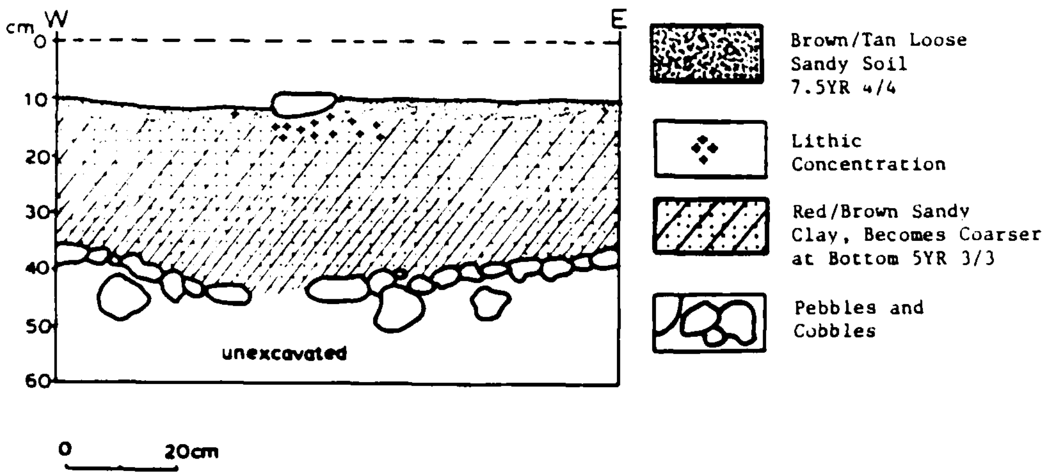
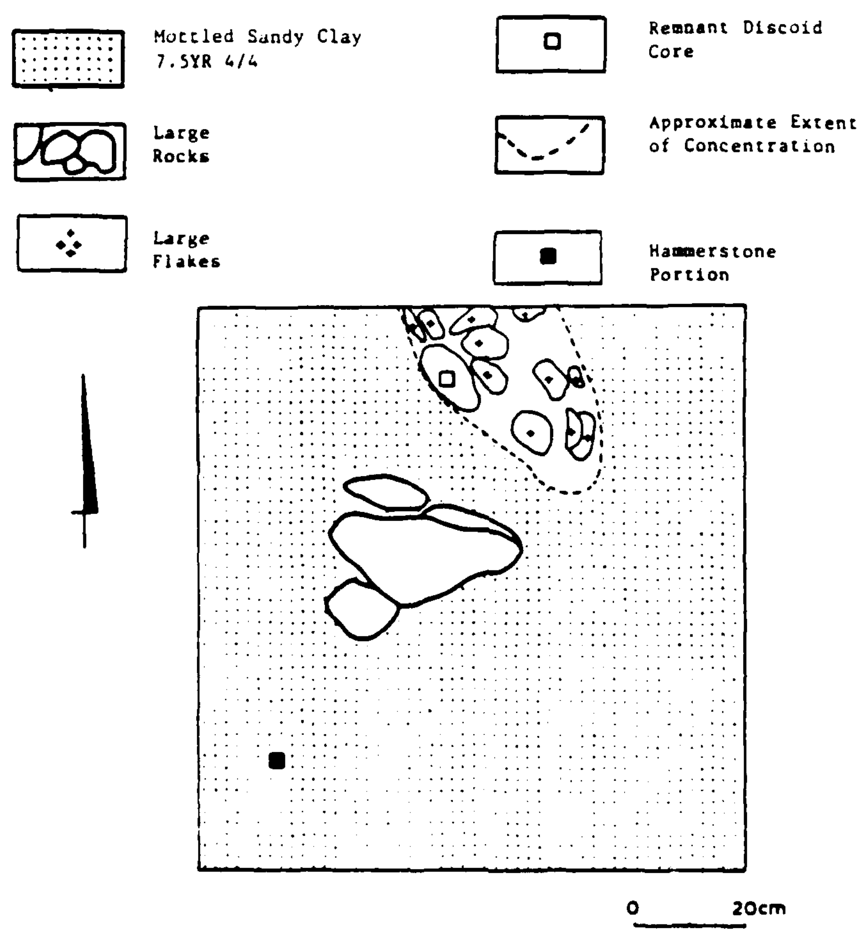


Figure 6.12 LA 25328, N53/E129, Base of Level 3, Feature 1, North Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



chipping feature. Nonfeature fill was screened through 1/4-inch mesh. Immediately under the surface at the northern end of the southernmost unit, an extremely dense concentration of flakes was encountered (Figure 6.13). When fully excavated, this concentration measured about 55 cm long by 25 cm wide and extended to a depth of between 10 and 15 cm below surface. The feature was bowl-shaped in vertical cross section. It was composed almost entirely of tightly packed flakes, angular debris, and core remnants; more than 900 artifacts were recovered from three levels within these two units. Feature fill was screened through 1/8-inch mesh. All materials recovered were chert, except for a single large obsidian scraper and a number of obsidian pressure flakes (see section 6.2.6). Although most of these artifacts came from within the feature itself, an appreciable number of smaller flakes was found in situ in the surrounding soils. The feature was judged in the field to represent a cache of lithic materials which had been placed in a shallow hole. Excavation of both units was terminated, at a depth of around 25 to 30 cm in an apparently sterile layer of clay and gravel. The contents of the feature were subject to preliminary refit analysis by a member of the field crew (Steven Kuhn personal communication 1985). Numerous refits were reported (see section 6.2.7.8).

Figure 6.13 LA 25328, N54/E129, Level 1, Feature 1, Lithic Cache, Abiquiu Archaeological Study, ACOE, 1989.



6.2.6 Chronology

Sixteen partially diagnostic projectile points and fragments were collected at LA 25328 (see Chapter 8 for a complete description). Two of these are small, serrate-edged arrow points. Three large, corner-notched dart points -- of chert, obsidian, and silicified mudstone, respectively -- were also collected. These are similar to En Medio types described by Irwin-Williams (1973). Seven of the remaining specimens are fragments of straight or expanding based, stemmed points of the Armijo, San Jose, or Bajada types also described by Irwin-Williams (1973). Most of these are too fragmentary for secure attribution. One heavily reworked basalt specimen could be classed as a Bajada point, while another obsidian specimen appears to represent the concave base of a San Jose point. Two of the remaining specimens appear to be broken, heavily reworked fragments of large, concave-base, side-notched points. No clear spatial patterning among points of different types was noted (see Chapters 7 and 8).

6.2.7 Rough Sort and Detailed Lithic Analysis

LA 25328 is a very large, multicomponent lithic scatter encompassing several distinct surface concentrations. This was the largest site investigated during this project and yielded the most extensive collection of lithic materials of any of the sites studied. A total of 1,105 m^2 of the site was subjected to intensive surface collection in five separate collection units. Each of these surface units sampled a discrete scatter on the surface of LA 25328. The intervening areas exhibited much lower surface densities, due to either differential soil deposition or a real absence of artifactual materials. Four 1-m^2 test units were also excavated. The surface and subsurface proveniences at LA 25328 have been divided into 12 aggregate provenience units. These are described in Table 6.2. Provenience 12 consists of a buried cache of lithic materials located outside of the surface collection units. These materials are described in section 6.2.7.8. The materials recovered from this feature are not included in any of the site summary tables or descriptions which follow. These materials are quite distinctive from anything recovered from any other site or any other area at LA 25328, and including them in site summary statistics would bias attempts at intersite comparisons.

Excluding Provenience 12, a total of approximately 9,061 artifacts was collected from surface and subsurface units at LA 25328 (Table 6.3). Pedernal chert is the most common lithic material, followed by Polvadera obsidian and a distinctive variety of quartzitic sandstone, although the relative frequencies of these materials vary significantly among provenience units (Table 6.4). Because of the number of provenience units and the apparent diversity among them, assemblage composition and attribute structure are discussed by collection or provenience unit only, rather than on a whole-site basis.

Samples for more detailed analysis totalled five percent of the total assemblage and were selected by grid from provenience Units 2 (61 artifacts), 4 (153 artifacts), 6 (119 artifacts), and 10 (111 artifacts). Provenience 2 is a low density unit, while the other three proveniences are high density units. The results of detailed analyses are presented in conjunction with rough sort data, by provenience.

Table 6.2 LA 25328 Provenience Units, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Surface Unit	Density	Grids
1	1	low	entire unit
2	2	low	entire unit
3	3	low	all except Prov. 4 next line
4	3	high	50-54N/148-157E 55-60N/148-153E 58-61N/143-147E
5	4	low	all except Prov. 6 next line
6	4	high	40-45N/80-90E 46-49N/80-85E
7	2	low	subsurface - 148N/63E (in Prov. 2)
8	5	low	all except Prov. 10 next line
9	N.A.[1]	N.A.	isolated artifacts
10	5	high	80-97N/100-107E 85-95N/108-112E
11	5	high	subsurface - 88N/101E (in Prov. 10)
12	N.A.	N.A.	subsurface - 53-54N/129E (cache)

1 N.A. = Not Applicable.

Table 6.3 LA 25328 Artifact Types by Provenience (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Bifaces	Cores	Drills	Flakes	Knappers	Large Angular Debris	Miscellaneous	Projectile Points	Small Angular Debris	Unifaces	Total
1	3(1)	1(<1)	--(--)	240(94)	--(--)	--(--)	--(--)	--(--)	12(5)	--(--)	256
2	1(2)	--(--)	--(--)	59(94)	--(--)	--(--)	--(--)	--(--)	3(5)	--(--)	63
3	--(--)	--(--)	--(--)	281(97)	--(--)	--(--)	--(--)	2(1)	3(1)	2(1)	288
4	19(2)	1(<1)	--(--)	1,006(97)	--(--)	--(--)	--(--)	--(--)	15(1)	1(<1)	1,042
5	--(--)	1(<1)	--(--)	204(96)	--(--)	--(--)	--(--)	2(1)	5(2)	1(<1)	213
6	--(--)	2(<1)	1(<1)	973(98)	--(--)	--(--)	--(--)	--(--)	16(2)	--(--)	992
7	--(--)	--(--)	--(--)	2(100)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	2
8	3(<1)	4(<1)	--(--)	825(95)	1(<1)	1(<1)	2(<1)	3(<1)	26(3)	--(--)	865
9	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	8(100)	--(--)	--(--)	8
10	15(<1)	9(<1)	--(--)	4,871(98)	--(--)	1(<1	--(--)	1(<1)	77(2)	--(--)	4,974
11	1(<1)	1(<1)	--(--)	347(97)	--(--)	--(--)	--(--)	--(--)	9(3)	--(--)	358
Total	42(<1)	19(<1)	1(<1)	8,808(97)	1(<1)	2(<1)	2(<1)	16(<1)	166(2)	4(<1)	9,061

6.2.7.1 Provenience 1

Provenience 1 includes all of surface collection Unit 1, a 10 x 10 m block which sampled an area of sparse artifact scatter over thin soils and bedrock. The provenience contains a total of 256 artifacts, including 240 flakes, 12 pieces of angular debris, three bifaces, and a core. Provenience 1 is heavily dominated by artifacts manufactured of Polvadera obsidian (80 percent), followed by Pedernal chert (17 percent), with small quantities of Jemez obsidian and quartzitic sandstone.

Polvadera obsidian artifacts from Provenience 1 include two bifaces, four pieces of angular debris, and 200 flakes.

The Pedernal chert artifacts exhibit a similar range of attributes to the obsidian within Provenience 1. A total of 44 flakes of this material was recovered. Approximately 35 percent of the chert flakes had been successfully heat treated while around six percent had been burned or overtreated (Table 6.5).

Table 6.4 LA 25328 Raw Material by Provenience (Column Percentage in Parenthesis), Abiquiu Archaeological Study, ACOE, 1989.

Material	Provenience 1	2	3	4	5	6	7	8	9	10	11	Total
Brown Jasper	--(--)	1(<1)	--(--)	--(--)	--(--)	5(<1)	--(--)	1(<1)	--(--)	24(<1)	3(<1)	34
Fossiliferous Cream Chert	--(--)	--(--)	--(--)	1(<1)	--(--)	--(--)	--(--)	1(<1)	--(--)	1(<1)	--(--)	3
Fossiliferous Tan Chert	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	1(<1)	--(--)	--(--)	--(--)	1
Green Chert	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	1(<1)	--(--)	1
Jemez Obsidian	3(1)	2(<1)	1(<1)	4(<1)	2(<1)	11(1)	--(--)	6(1)	2(25)	32(1)	2(<1)	65
Miscellaneous Chert	--(--)	2(<1)	--(--)	--(--)	--(--)	1(<1)	--(--)	1(<1)	--(--)	8(<1)	--(--)	12
Morrison Chert	--(--)	--(--)	--(--)	1(<1)	--(--)	--(--)	--(--)	--(--)	--(--)	7(<1)	--(--)	8
Moss Jasper	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	2(<1)	--(--)	31(<1)	--(--)	33
Nacimiento Chert	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	2(<1)	--(--)	2(<1)	--(--)	4
Pedernal Chert	44(17)	19(30)	264(92)	860(82)	180(85)	809(81)	--(--)	606(70)	3(38)	4,004(81)	301(85)	7,090
Polvadera Obsidian	206(80)	22(35)	23(8)	167(16)	28(13)	156(16)	2(100)	162(19)	2(25)	582(12)	27(8)	1,377
Quartzitic Sandstone	3(1)	14(22)	--(--)	8(1)	2(1)	9(1)	--(--)	78(9)	--(--)	246(5)	23(6)	383
Quartzite	--(--)	2(<1)	--(--)	--(--)	--(--)	--(--)	--(--)	3(<1)	--(--)	20(<1)	2(<1)	27
Silicified Wood	--(--)	1(<1)	--(--)	1(<1)	1(<1)	1(<1)	--(--)	1(<1)	--(--)	15(<1)	--(--)	20
Vitrophyre	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	1(<1)	1(12)	1(<1)	--(--)	3
Total	256	63	288	1,042	213	992	2	865	8	4,974	358	9,061

Table 6.5 LA 25328 Heat Treatment by Artifact Type, Chert Only, Units 1 and 2, Abiquiu Archaeological Study, ACOE, 1989.

	None		Total Treated		Successful		Unsuccessful		
	#	%	#	%	#	%	#	%	Total
Biface Flake	--	--	1	100	1	100	--	--	1
Core Flake	13	54	11	46	10	91	1	9	24
Small Angular Debris	6	60	4	40	2	50	2	50	10
Unidentified Flake	18	64	10	36	9	90	1	10	28
Total	37	59	26	20	22	30	4	6	63

The combined lithic data from Provenience 1 are primarily indicative of manufacturing activities. Most of the flakes of the major material types appear to have been produced in the course of primary and secondary core reduction using raw materials on which a significant amount of cortex remained. A limited amount of formal tool (biface) manufacture on Polvadera obsidian is also indicated by the presence of bifacially retouched platforms and the broken preform. Evidence of expedient tool use is limited to a single retouched flake, while resharpening activities do not seem to be represented at all. Only the artifacts of silicified sandstone seem to break this pattern, but there are too few to draw any generalizations. The presence of large quantities of apparent core reduction debris with no associated cores is somewhat puzzling, although it may relate to the use of transported cores for either the production of tool blanks or the production of flakes to serve as expedient tools in activities which leave few obvious macrowear traces.

6.2.7.2 Provenience 2

Provenience 2 comprises all of surface Unit 2, a 10 x 10 m collection area located on a low density scatter in deep, sandy soils. This unit yielded a total of 63 artifacts, all of which were subject to rough sort and detailed analyses. Artifacts recovered include one biface, 59 flakes, and three pieces of small angular debris. Dominant materials are Polvadera obsidian (39 percent), Pedernal chert (24 percent), and quartzitic sandstone (19 percent), with small quantities of other local cherts, Jemez obsidian, quartzites, and silicified wood. One flake recovered was a yellow silicified wood (Warren [1967] material code 1150) which is thought to originate in the San Juan Basin (Chapman 1977:429) but which may be present in local gravels in the Abiquiu area as well.

Polvadera obsidian artifacts recovered from Provenience 2 include one biface and 21 flakes.

Artifacts manufactured of Pedernal cherts include 17 flakes and two angular fragments.

All of the 14 quartzitic sandstone artifacts collected in Provenience 2 are flakes.

Two retouched flakes were recovered from Provenience 2, one with bidirectional retouch and one with unidirectional retouch. A single flake of Pedernal chert also shows evidence of bidirectional use wear. No utilization was observed on any flake platforms or on the single formal tool collected.

The small number of artifacts collected from Provenience 2 attests to primary and secondary core reduction/flake production activities with limited bifacial tool manufacture in obsidian and silicified sandstone. In general, these results are similar to those from Provenience 1 except for the different suite of raw materials. The presence of the two retouched flakes and one utilized flake also indicates that a limited set of processing or manufacturing activities aside from lithic reduction was carried out in this area.

6.2.7.3 Provenience 7

Provenience 7 is a subsurface, test excavation unit located at grid coordinates 148N/63E, within Provenience 2. The unit was excavated to check for buried, high density, subsurface deposits beneath the sandy aeolian soils in surface collection Unit 2. The only artifacts recovered from this provenience were two Polvadera obsidian flakes.

6.2.7.4 Surface Unit 3: Proveniences 3 and 4

Provenience 3 includes low density grids (fewer than 10 artifacts/m^2) from surface collection Unit 3. These grids were analyzed separately from the high density grids (Provenience 4) in order to test for density-dependent variation in artifact deposition. Collection Unit 3 was a 15 x 15 m surface unit located in an area in the southeast corner of LA 25328 which was characterized by denuded, eroding soils.

Heat treatment of cherts in Proveniences 3 and 4 is limited almost entirely to Pedernal cherts. Of rough sorted lithics, 53 percent of chert artifacts were untreated, 83 percent successfully treated, and 17 percent overtreated or burned. With the exception of a single biface fragment, all artifacts appear to have been subjected to heat treatment while still attached to the core (Table 6.6).

Provenience 3. A total of 288 artifacts, including 281 flakes, two points, two unifaces, and three pieces of small angular debris, was recovered from the low density grids in collection Unit 3. Ninety-two percent of these artifacts are of Pedernal chert and eight percent of Polvadera obsidian; a single flake of Jemez obsidian was also collected.

Pedernal chert artifacts from Provenience 3 include a point, one uniface, three pieces of angular debris, and 259 flakes.

Artifacts of Polvadera obsidian include one point and 22 flakes.

Table 6.6 LA 25328 Heat Treatment by Artifact Type, Chert Only, Unit 3, Abiquiu Archaeological Study, ACOE, 1989.

	None #	None %	Total Treated #	Total Treated %	Successful	Unsuccessful	Successful Core	Total % Successful	Total
Biface Flake	18	50	18	50	16	1	1	94	36
Biface	--	--	6	100	6	--	--	--	6
Multiplatform Core	--	--	1	100	--	1	--	--	1
Core Flake	282	50	277	50	186	56	35	80	559
Pressure Flake	1	33	2	67	--	1	1	50	3
Projectile Point	1	50	1	50	1	--	--	100	2
Small Angular Debris	8	47	9	53	5	4	--	56	17
Unidentified Flake	260	56	204	44	164	25	15	88	464
Unifacially Retouched Flake	18	60	12	40	10	--	2	100	30
Uniface	2	67	1	33	--	1	--	--	3
Total	590	53	531	47	388	89	54	83	1,121

A single obsidian flake shows unidirectional marginal retouch. Formal tools from Provenience 3 include two end scrapers, one of untreated Pedernal chert and one of Polvadera obsidian, a single fragment of an obsidian bifacial preform, and a broken preform of heat treated Pedernal chert. None of these artifacts exhibit any detectable edge damage.

As in the other proveniences discussed thus far, the lithic materials from Provenience 3 appear to be largely indicative of reduction, rather than tool manufacture or use, activities. Only a single retouched flake was recovered as evidence of expedient tool production and use. Three flakes with retouched platforms were classed as uniface flakes, and the rest as biface flakes (based on platform morphology). This, along with the presence of the two scrapers and two biface preforms, may indicate that a limited amount of formal tool manufacture and resharpening took place in the area. The presence of use damage on a number of faceted flake platforms suggests the use of cores in some kinds of processing activity, although not necessarily on the spot. The majority of debris seems to be attributable to activities involving core reduction and flake preparation. The two most common material types are treated more or less similarly. Polvadera obsidian seems to show a greater tendency towards biface manufacture and the later stages of core reduction, but samples are too small to support such a generalization for this provenience.

<u>Provenience 4</u>. This provenience represents a strip of high density grids running from southeast to northwest through the center of surface Unit 3. This density contour seems to parallel the course of a small drainage channel

which runs through the area, but field notes do not mention evidence of major artifact movement and redistribution.

Provenience 4 yielded a total of 1,042 artifacts, including 19 biface fragments; one uniface; one core; 1,006 flakes; and 15 pieces of angular debris. Eighty-two percent of these artifacts are Pedernal chert, 16 percent are Polvadera obsidian, and the remainder is manufactured from a variety of local cherts. Four of the artifacts are of Jemez obsidian.

Artifacts manufactured of Pedernal chert from Provenience 4 include four bifaces, a core, one point, a uniface, and 14 pieces of angular debris. Ninety-seven percent (833) are flakes.

The Polvadera obsidian artifacts collected from Provenience 4 include eight bifaces and 158 flakes.

Five flakes (three chert, two obsidian) exhibit unidirectional retouch and use wear. Formal tools far outnumber informal or casual tools, however. Of the 19 bifaces and fragments recovered, eight (four Polvadera obsidian, three Pedernal chert, and one silicified wood) represent an early preform stage. Two biface blanks (both of chert) and three late preforms (two obsidian, one chert), as well as two completed biface fragments (one each of chert and obsidian), round out the biface total. Two additional biface fragments were originally classified as parts of projectile points but were not included by Lintz in the point discussion (Chapter 8). One is a large, basally and side-notched palmate dart point fragment manufactured of heat treated Pedernal chert. This artifact resembles a larger version of points typically called Navajo or Apachean (Klager 1980:98). The second point is a basal fragment of an indeterminate, unnotched palmate dart point, manufactured of Polvadera obsidian. A single, complete uniface of burned Pedernal chert was also recovered.

Provenience 4 evidences a wide range of technological activities involving both chert and obsidian. Pedernal chert and Polvadera obsidian also appear to have been used in a mix of manufacturing and recycling activities. The chert assemblage is heavily dominated by faceted platforms and shows a much lower percentage of platform use or wear. This, along with the relatively low percentage of dorsal cortex and the presence of angular debris, suggests a predominance of core reduction and flake production tending towards the later (i.e., postcortex removal) stages. The presence of both unidirectional and bidirectional retouched platforms and evidence of platform preparation, along with the seven fragments of partially worked bifaces, indicates significant chert bifacial tool manufacturing at the site. Renewal of formal tools is also indicated by flakes with use evidence on the platforms. The Polvadera obsidian sample from Provenience 4 shows a much heavier emphasis on biface manufacture, with a high percentage of retouched platforms, platform preparation or indeterminate damage, and the relatively high frequency of incomplete bifaces (four percent of the total, as opposed to one percent for chert). Activities involving core reduction and/or flake production are also indicated, again primarily the later stages. Only very limited use of expedient tools in processing or manufacturing activities is indicated by the five marginally retouched/utilized flakes.

The difference in the treatment of Pedernal chert and Polvadera obsidian within Provenience 4 could be due to two basic factors. 1) It is possible that obsidian was simply the preferred material for biface manufacture at the time these materials were deposited. 2) The observed patterning could also reflect a logistical or procurement effect. Polvadera obsidian may have been transported farther than Pedernal chert, which is abundantly available only a few kilometers from LA 25328 in the form of lag gravels. In a logistically organized system, where lithic procurement is embedded (Binford 1978) in another activity (such as hunting), materials from relatively distant sources would be expected to reach a given location primarily in the form of finished tools, multipurpose blanks or preforms, or transportable cores. Local material, on the other hand, would be present in rawer form, and consequently processed by different techniques (i.e., conventional core reduction). These hypotheses could be tested using data on platform use or preparation from biface flakes, but the predominance of indeterminate use/preparation on artifacts from Provenience 4 makes this impossible at present.

Summary. A chi-square test of debitage and tools from Proveniences 3 and 4 resulted in a value of 0.36, suggesting a possibility between 50 percent and 70 percent that differences in tool and debitage proportions are due to chance. The similarity of the two assemblages supports the idea that variations in surface density within surface Unit 3 are the results of sampling different intensities of deposition from the same range of activities, and not different sets of activities producing varying quantities of debris. Given the relatively small scale of the collection unit, this is not a surprising finding.

6.2.7.5 Surface Unit 4: Proveniences 5 and 6

The surface grids from collection Unit 4 were divided into two proveniences on the basis of differential density. The low density grids (fewer than five artifacts/m^2) were subsumed under Provenience 5, while a block of high density grids at the western edge of the 10 x 20 m unit was designated as Provenience 6. Surface Unit 4 sampled a moderate density scatter situated in the area of stable, gravelly soil at the top of a small finger ridge leading away from the main site area.

Heat treatment is limited to Pedernal chert in the assemblages from Proveniences 5 and 6. Thirty-seven percent of the artifacts of this material show signs of heat treatment. Only one specimen, a uniface recovered from one of the low density grids in Provenience 5, exhibits a thermal surface on the ventral side, indicative of heat treatment in flake form (Table 6.7).

Provenience 5. Artifacts recovered from the low density grids on the eastern end of collection Unit 4 include one core, 204 flakes (96 percent), one uniface, two projectile points, and five pieces of small angular debris. Eighty-one percent of this subassemblage is Pedernal chert, 15 percent is Polvadera obsidian, two flakes are of Jemez obsidian, two flakes are of quartzitic sandstone, and a few pieces of other, locally obtainable cryptocrystalline materials complete the assemblage.

Table 6.7 LA 25328 Heat Treatment by Artifact Type, Chert Only, Unit 4, Abiquiu Archaeological Study, ACOE, 1989.

	None		Total Treated		Successful	Unsuccessful	Successful Core	Total % Successful	Total
	#	%	#	%					
Biface Flake	8	22	28	78	22	1	5	96	36
Single Platform Core	1	50	1	50	--	1	--	--	2
Core Flake	167	48	180	52	135	32	13	82	347
Drill	--	--	1	100	1	--	--	100	1
Exhausted Multiplatform Core	1	100	--	--	--	--	--	--	1
Heat Spall	--	--	1	100	1	--	--	100	1
Pressure Flake	4	36	7	64	--	--	7	100	11
Small Angular Debris	8	44	9	56	7	1	1	89	17
Unidentified Flake	281	49	291	51	245	35	11	88	572
Uniface	--	--	1	100	1	--	--	100	1
Total	470	48	519	52	412	70	37	87	989

A total of 134 flakes, five pieces of angular debris, and one core from Provenience 5 is manufactured of Pedernal chert.

The Polvadera obsidian assemblage from Provenience 5 includes 26 flakes and two projectile points.

Neither marginal retouch nor evidence of utilization was recorded on artifacts from Provenience 5. Three formal tools were collected, however. These include a uniface made on a flake of heat treated Pedernal chert, and two fragmentary projectile points of Polvadera obsidian. One of these points is a small, corner-notched arrow point while the other is a basal fragment of a large, corner-notched, dart-sized point, possibly of the En Medio type.

The presence of several formal tools (more than one percent of the total), the absence of any use damage on platforms or flake edges, and the low frequency of bifacially retouched platforms are several distinguishing characteristics of this small group of artifacts from Provenience 5. Because of the small size of this subassemblage and the arbitrary division of provenience units within surface collection Unit 4, these data are discussed in conjunction with the materials from Provenience 6, below.

Provenience 6. Provenience 6, or the denser western portion of surface collection Unit 4, yielded a total of 992 artifacts. The vast majority of these (98 percent) is flakes. Two cores, 16 pieces of angular debris, and a fragmentary bifacial drill tip complete the assemblage. The proportions of different lithic materials are essentially identical to those of Provenience 5: 81 percent Pedernal cherts, 15 percent Polvadera obsidian, with very small

quantities of miscellaneous cherts, Jemez obsidian (11 specimens), quartzitic sandstone, and vitrophyre.

Artifacts from Provenience 6 manufactured of Pedernal chert include 794 flakes, two cores, 12 pieces of small angular debris, and the drill tip.

One of the two Pedernal chert cores recovered from this provenience is a single-platform core of burned or unsuccessfully heat treated material. The other is a small, possibly exhausted, multiplatform core of untreated material.

The sample of Polvadera obsidian artifacts from Provenience 6 includes 152 flakes and four pieces of small angular debris. A somewhat larger than usual percentage (19 percent) retains some dorsal cortex, and three percent have cortex over more than 50 percent of the artifacts' dorsal surfaces.

A small distal fragment of a bifacial drill constitutes the only formal tool recovered from Provenience 6. In addition, two flakes of Polvadera obsidian exhibit traces of unidirectional marginal retouch.

Summary. The two proveniences within surface collection Unit 4 are remarkably similar in terms of platform and dorsal cortex attributes as well as raw material composition. Overall, Proveniences 5 and 6 appear to reflect technological activities mainly associated with primary and secondary core reduction and flake production. The frequencies of cortical and faceted platforms are particularly high, although dorsal cortex is not unusually frequent except on obsidian from Provenience 6. A limited amount of biface and possibly uniface manufacture or renewal is in evidence although the frequency of retouched platforms is relatively low. To whatever degree biface working is represented in these assemblages, it appears to have been primarily a renewal as opposed to a manufacturing activity. This is indicated by the dominance of platform use (as opposed to preparation) damage on retouched platforms, as well as the absence of broken early stage bifaces. The presence of only two casually retouched, and no utilized unretouched, flakes in an assemblage of over 1,000 pieces indicates that processing or nonlithic manufacturing activities were probably not important in contributing to the formation of these assemblages.

Proveniences 5 and 6 stand in strong contrast to the assemblages from surface Unit 3 (6.2.7.4) in relation to the relative importance of biface manufacture versus core reduction/flake production debris. There is also a clear contrast with Proveniences 3 and 4 in the treatment of Polvadera obsidian and Pedernal cherts. In Proveniences 5 and 6 there is little or no difference in the treatment of chert and obsidian. If anything, the frequencies of cortex and platform types suggest that obsidian from Proveniences 5 and 6 may have been derived slightly less frequently from bifaces, as opposed to single- or multiplatform cores, than the chert. The factors responsible for the differences between Proveniences 5 and 6, on one hand, and Proveniences 3 and 4, on the other, could be chronological, synchronic/functional, or both. The projectile points cast little light on this possibility, given the obvious temporal span represented by the two points recovered from Provenience 5, but obsidian hydration data may be somewhat more informative.

As discussed above, there are few obvious differences between the assemblages from the sparse (Provenience 5) and dense (Provenience 6) grids within surface Unit 5. It is interesting that three of the four complete formal tools came from the sparse grids, which yielded less than one-fourth the number of artifacts of the other provenience. This could reflect different disposal and abandonment processes responsible for the deposition of finished formal tools, as opposed to debris, but this sample alone is too small and too spatially limited to support any further analysis. The spatial analysis in section 9.2 indicates, however, that tools tend to co-occur in high density lithic clusters on both LA 27002 and LA 25480, suggesting that the Provenience 5 and 6 pattern is spurious.

6.2.7.6 Surface Unit 5: Proveniences 8, 10, and 11

Collection Unit 5 was a 20 x 24 m block of grids located near the geographic center of LA 25328. This unit sampled the area with highest observed surface artifact density, approaching 70 artifacts/m^2 in some grids. This part of the site is characterized by fairly deep, sandy soils of possible aeolian origin. Collection Unit 2 (Provenience 2) adjoins collection Unit 5 at the latter's northeastern corner. This unit was divided into two proveniences based on artifact density. Provenience 8 is made up of low density grids (fewer than 15 artifacts/m^2), while Provenience 10 is a large block of high density grids. Provenience 11 represents a test pit at grid location 88N/110E within the highest density portion of Provenience 10.

The assemblages from collection Unit 5 show a somewhat higher proportion of successful heat treatment (65 percent) on Pedernal chert artifacts than do the assemblages from other portions of the site. An additional three percent of Pedernal chert artifacts are burned or unsuccessfully heat treated. With the exception of three biface fragments, heat treatment appears to have involved cores rather than flakes (Table 6.8).

Provenience 8. The low density grids within collection Unit 5 yielded a total of 865 artifacts, including five bifaces, one definite and two possible projectile points, four cores, 825 flakes, 26 pieces of angular debris, and one knapper. Seventy percent of the assemblage is made of Pedernal chert, 19 percent of Polvadera obsidian, and nine percent of quartzitic sandstone. Small quantities of Jemez obsidian, vitrophyre, quartzite, and miscellaneous local cherts were also recovered.

Of the 607 Pedernal chert artifacts from Provenience 8, 96 percent are derived from cores and three percent angular debris. Three cores and a biface of this material were also collected.

The Polvadera obsidian artifacts from Provenience 8 include one biface, one bifacial core, and 160 flakes.

Table 6.8 LA 25328 Heat Treatment by Artifact Type, Chert Only, Unit 5, Abiquiu Archaeological Study, ACOE, 1989.

	Total		Total Treated						
	#	%	#	%	Successful	Unsuccessful	Successful Core	Total % Successful	Total
Miscellaneous	1	50	1	50	1	--	--	100	2
Biface Flake	50	16	259	84	250	3	6	99	309
Biface	1	8	11	92	10	1	--	91	12
Biface Core	--	--	1	100	1	--	--	100	1
Multiplatform Core	--	--	4	100	4	--	--	100	4
Single Platform Core	1	50	1	50	1	--	--	100	2
Core Flake	358	33	740	67	679	54	7	93	1,098
Large Angular Debris	1	100	--	--	--	--	--	--	1
Pressure Flake	3	25	9	75	--	--	9	100	12
Small Angular Debris	38	47	43	53	40	3	--	93	81
Unidentified Flake	1,070	32	2,316	68	2,208	76	31	97	3,386
Unifacially Retouched Flake	--	--	2	100	--	--	2	100	2
Total	1,523	36	3,387	69	3,194	137	55	66	4,910

The assemblage of quartzitic sandstone artifacts from Provenience 8 consists of 68 flakes, seven pieces of angular debris, three bifaces, a projectile point fragment, and a dorsally battered knapper.

Informal tools collected at Provenience 8 include one extensively retouched flake of quartzitic sandstone and one Pedernal chert flake with unidirectional marginal retouch. Neither shows evidence of use damage. Formal tools include a fragmentary early preform of heat treated Pedernal chert and another of quartzitic sandstone. Two artifacts of the latter material may also be fragments of hafted projectile or knife elements: these include the basal section of a very large, corner-notched biface, and the midsection of what may have been a small arrow point. The basal fragment of a large, stemmed or broadly side-notched point of Jemez obsidian also came from this provenience.

Discussion of the lithic data from Provenience 8 is included with discussion of the other two proveniences, at the end of this section.

Provenience 10. The high density portion of collection Unit 5 yielded a total of 4,974 artifacts, including 15 bifaces; one projectile point; nine cores; 78 pieces of angular debris; and 4,871 flakes. This assemblage is made up of 82 percent Pedernal chert, 12 percent Polvadera obsidian, and five

percent quartzitic sandstone, along with a variety of other materials of local origin. Jemez obsidian, a moss jasper, and a brown jasper are present in small (less than one percent) but significant frequencies.

The portion of the assemblage made of Pedernal chert includes 98 percent flakes and 1.5 percent angular debris. Eleven biface fragments and three cores of this material were also collected. A very large percentage of the chert artifacts (98 percent) lacks dorsal cortex, and less than one percent of the total has greater than 50 percent cortex.

The Polvadera obsidian artifacts from Provenience 10 include only flakes (99 percent) and small angular debris (one percent). Only four percent show any dorsal cortex, and only five pieces have more than 50 percent cortex.

Of the 246 quartzitic sandstone artifacts collected from Provenience 10, 93 percent are flakes. Also collected were four bifaces, five cores, a projectile point, and nine pieces of angular debris. Cortex is relatively common, being present on 16 percent of the artifacts manufactured of this material, and three percent have cortex over more than 50 percent of the artifacts' dorsal surfaces.

A small sample (31 artifacts) of moss jasper was collected from Provenience 10, including 30 flakes and one piece of angular debris. Only one piece showed any signs of dorsal cortex, but a surprisingly high percentage of cortical platforms (27 percent) was noted.

Twenty-four flakes of a brown jasper were also collected in Provenience 10. Cortex is absent on 83 percent of these flakes.

The small sample of Jemez obsidian artifacts included 31 flakes and one fragment of angular debris. Only nine percent of the artifacts of this material have any dorsal cortex.

One multiplatform core of silicified wood was also collected from Provenience 10.

Informal tools collected at Provenience 10 include three flakes with unidirectional retouch (one extensive) and two with evidence of dorsal battering, possibly identifying them as spalls from ground stone sharpeners, hammers, or other percussors. Two flakes also exhibit use damage, one unidirectional and one bidirectional. All formal tools are bifacial. Artifacts of quartzitic sandstone include fragments of one early stage preform, one late stage preform, and one finished biface. The remainder of the biface fragments was manufactured of Pedernal chert. Formal tools made of untreated chert include fragments of one early stage preform, one late stage preform, and one more or less complete biface. Three early stage preform fragments and one late stage preform are made of chert, heat treated in core form, while two early and one late stage preform fragments show signs of having been heat treated in flake form. One other late biface preform fragment is made of burned chert. The basal fragment of a stemmed, lanceolate or palmate dart point manufactured of quartzitic sandstone was also recovered from Provenience 10. This is the only ground stone artifact recovered from the entire site.

Provenience 11. The assemblage from the test pit which constitutes Provenience 11 consists of one biface, one core, 347 flakes, and nine fragments of angular debris. Eighty-four percent of these artifacts are manufactured of Pedernal chert, nine percent are made of Polvadera obsidian, and eight percent are made of quartzitic sandstone. Three flakes of brown jasper and two of quartzite were also recovered. The single core recovered is of the multiplatform type.

Pedernal chert artifacts from Provenience 11 include 292 flakes, a core, and eight pieces of angular debris. Only two percent show any dorsal cortex.

The Polvadera obsidian artifacts from Provenience 11 consist of 27 flakes. Only one flake has any dorsal cortex.

The artifacts from Provenience 11 manufactured from quartzitic sandstone include a biface fragment, 21 flakes, and a single piece of angular debris. Ninety-one percent of the artifacts lack dorsal cortex, and none has more than 50 percent dorsal cortex coverage.

Summary. As in the cases of the proveniences discussed previously, the high and low density areas within collection Unit 5 (Proveniences 8 and 10, respectively) show a high degree of similarity. The full range of technological activities, including core reduction/flake production, biface manufacture, and the renewal of formal tools, is indicated. Many bifaces and cores were recovered although their relative frequency is lower than in Proveniences 3 and 4. The relative number of informal or expedient tools is very low (approximately 0.01 percent) in Proveniences 8 and 10. The presence of a mano, along with dorsally battered spalls which may be attributable to ground stone sharpeners, indicates that ground stone artifact maintenance and food processing activities were probably carried out in this portion of the site as well.

A number of interesting differences are present in the relative importance of various technological activities among the major material types. Pedernal chert appears to have been employed in the widest variety of technological activities. Numerous cores and the predominance of flakes with faceted platforms indicate core reduction/flake production activities. The presence of many broken, unfinished biface fragments, most of which are probably manufacturing failures, as well as the moderate frequency of retouched platforms, suggests that biface manufacture was another activity carried out in this area. Platform damage evidence is sparse but indicates both manufacture and resharpening of utilized implements. Polvadera obsidian appears to have been employed in a similar range of activities, but the absence of manufacturing failures indicates that the full range of manufacturing activities for this type is not reflected in LA 25328 assemblages. Instead, only core reduction and late stage manufacture or artifact renewal are indicated.

The quartzitic sandstone presents a highly contrasting picture. Retouched platforms are rare. Faceted platforms, flakes with dorsal cortex, cores, and early stage bifacial artifacts are very common, occurring with a much greater relative frequency than for Pedernal chert. The implication is that core reduction and early stage bifacial tool manufacture were the

dominant activities conducted with this material. In addition, the quartzitic sandstone material exhibits the highest proportion of finished bifacial artifacts (projectile point fragments and complete bifaces) but the lowest proportion of retouched platforms, indicative of working such artifacts on the spot.

The reasons for the differences in the utilization of these various raw materials are difficult to isolate based on these data alone. The different manufacturing stages represented may well be a function of different modes of procurement and different patterns of raw material availability. Polvadera obsidian derives from the most distant source and may have been transported to the site primarily in the form of late stage or finished tools as well as transportable cores capable of yielding useful flakes or blanks. The Pedernal chert, the most immediately and widely available material, is represented in all manufacturing stages and comprises most of the informal, expedient tools as well. The origin of the quartzitic sandstone is not known. The material was used in Proveniences 8, 10, and 11 primarily for early manufacturing stages but also appears in the form of broken, complete tools. It might be that the quartzitic sandstone has a local origin and that it was employed in this location primarily for making and replacing tools or blanks for use in other contexts.

It was originally thought that the small quantities of jaspers and Jemez obsidian recovered from Provenience 11 would represent the remains of single cores introduced into the area. The presence of both retouched and faceted platforms in all materials suggests too wide a range of manufacture stages to be the remains of single cores, in light of the limited quantities of debris present. These rare materials are represented primarily in the form of core reduction, rather than formal tool renewal debris. This may indicate that their rarity is not a result of distance from source but possibly of low frequency in local gravels.

The assemblages from Proveniences 8 and 10 are quite similar, except in the relative frequencies of formal tools, as was observed for Proveniences 6 and 7. Provenience 11 is markedly different, however. This is the only provenience at LA 25328 discussed thus far in which retouched platforms predominate (in Pedernal chert and Polvadera obsidian, at least). Since no obvious stratigraphic breaks were noted during the excavation of this unit, it is safe to conclude that the test pit sampled a limited area with highly concentrated late stages of biface manufacture and resharpening debris within Provenience 10.

6.2.7.7 Provenience 9

Eight artifacts (normally formal tools) recorded from outside of the systematically collected surface units were grouped together into Provenience 9. These artifacts outside of collection units were all biface or possible projectile point fragments. These are described below. All noncollection unit artifacts were collected from the central portion of the site, closest to collection Unit 5.

Two of the artifacts were manufactured of Polvadera obsidian. One is an indeterminate fragment of a biface or point. The other is a fragment of a stemmed or broadly side-notched palmate dart point.

Two other artifacts were manufactured of Jemez obsidian. Both are basal fragments, one of a corner-notched palmate dart point and the other of an indeterminate point or thin biface.

Three isolated artifacts of heat treated Pedernal chert were collected from the surface at LA 25328. One is the basal fragment of a possible En Medio point. Another is a portion of a stemmed or corner-notched lanceolate dart point. The final specimen is a small fragment of an indeterminate palmate dart point.

A single fragment of a corner-notched palmate dart point, possibly of the En Medio type, was manufactured of basalt.

6.2.7.8 Provenience 12

Provenience 12 was a subsurface feature, a highly concentrated mass of buried lithic artifacts located outside of the surface collection units on the boundary of grids 53N/129E and 54N/129E. The feature consisted of a tightly packed, semicircular cluster of flakes and core fragments approximately 40 cm in diameter and 10 to 15 cm in depth. Although the feature was excavated in several levels, no clear distinction between the contents of these arbitrary levels was noted during analysis, and the entire contents of the feature will be treated as a single assemblage. Additional materials, including numerous flakes and a broken hammerstone, were recovered from the fill surrounding the densest part of the flake concentration; these materials will be described separately.

A total of 936 artifacts was recovered from the feature and surrounding fill. The vast majority of these artifacts consisted of flakes, flake fragments, or angular debris, but two cores, a hammerstone, and a large uniface or side scraper manufactured of Jemez obsidian were also recovered. Pedernal cherts make up approximately 95 percent of the total, with Polvadera obsidian making up an additional three percent. A few specimens of Jemez obsidian and locally available cryptocrystalline materials were also collected. Pedernal chert flakes from all levels and the surface show a high degree of patination, most having an opaque and chalky appearance on at least one surface. Similar patination is quite rare on surface artifacts from LA 25328 and other sites investigated during this project. It is possible that this patination is a function of the age of the artifacts in the feature, but it might also reflect differing local soil conditions.

There are a number of striking differences between the contents of the lithic concentration and the materials recovered from the surrounding soils. The mean length of artifacts (including broken items) found outside the feature is 8.4 mm, as opposed to 13.4 mm for those flakes found within the feature. A higher proportion of the flakes found outside the feature is broken (50 percent as opposed to 40 percent for the feature), and a higher proportion is of unidentifiable form (55 percent as opposed to 46 percent).

The artifacts which comprise the feature also differ significantly from those recovered from the remainder of LA 25328 and the rest of the sites investigated in this project. The technological and assemblage composition differences between the contents of the lithic feature and the detailed artifact sample are shown in Table 6.9.

Table 6.9 LA 25328 Comparison of Lithic Cache and Detailed Sample, Abiquiu Archaeological Survey, ACOE, 1989.

Attribute	Cache (LA 25328)	Detailed (All Sites)
% Whole Flakes	50%	24%
Mean Length (Whole Flakes Only)	25 mm	22.3 mm
Mean Thickness (Whole Flakes Only)	4.5 mm	6.2 mm
Platform Types (%)		
Cortical	0.9%	3.5%
Single-Facet	24.6%	24.4%
Multiple-Facet	9.4%	3.1%
Retouched-Unidirectional	6.4%	3.6%
Retouched-Bidirectional	3.3%	9.0%
Platform Use/Prep. (%) (All Types)	10.0%	10.0%
Dorsal Cortex (%)		
None	90%	85%
>50% Dorsal Cortex	1.7%	6.4%
Raw Materials (%)		
Pedernal Chert	95.7%	62.0%
Polvadera Obsidian	3.4%	30.0%
All Other Materials	0.9%	8.0%
Heat Treatment (%)		
Untreated	50.3%	57.5%
Successful	47.5%	29.8%
Unsuccessful/Burned	2.2%	12.7%

As Table 6.9 indicates, the lithic feature has an unusually high proportion of whole flakes, which tend to be larger and thinner than those from the combined surface proveniences. The materials from the feature also exhibit a somewhat different mix of platform attributes, suggesting an unusual type core technology (to be discussed in greater detail below). This observation is further supported by the fact that the two cores recovered from the feature are bifacial in form, a relatively rare type in surface assemblages. The feature also exhibits a somewhat lower mean amount of dorsal cortex coverage, and a much higher frequency of successful heat treatment, than the larger sample. Finally, the feature assemblage has a raw material composition dominated by a single material (Pedernal chert).

In fact, several technological features of the lithic materials fr this feature are more distinctive than the attribute data presented above indicate. A high proportion of the large flakes and fragments exhibits dorsal scar patterns and lateral curvature indicative of bifacial core technology. Such flakes are relatively rare in the surface assemblages, as are large bifacial cores. The high proportion of unidirectional platform retouch is not reflective of retouching unifaces, as in many of the surface assemblage examples, since it occurs on very large flakes. Instead, it seems to be a kind of platform preparation designed to aid in the production of large flakes (relative to core size) by creating a flat, broad striking platform. Several of the large scrapers collected from LA 25330 exhibit similar treatment. The overall technological appearance is so distinctive that it was originally thought that most of the debris from the feature represented the results of a single, massive core reduction episode. Further analyses and refitment indicated that this was not the case, however.

The preceding figures indicate that the concentration of lithics is quite distinctive relative to generalized surface assemblage from the Abiquiu sites. The high percentage of complete large, flat flakes, compared with both the detailed sample and the lithics from the fill surrounding the feature, combined with the highly concentrated nature of the deposit, supports the inference that the feature represents an intentionally assembled, perhaps cached mass of lithic materials. The cache is not highly selected, however, as indicated by the presence of broken flakes, very small pieces of debitage, and flakes representing a variety of stages of reduction (multiplatform types). As discussed below, the feature appears to represent the partially culled remnants of a limited series of reduction events, probably conducted in the immediate vicinity.

As part of an independent research effort conducted by Kuhn, an attempt was made to refit flakes and cores recovered from the cache feature at LA 25328. This technique is imprecise at best and requires vast amounts of patience and time, for trial and error refitment of individual pieces, in addition to a moderate degree of technological knowledge. After a total of approximately 40 hours, 32 flakes and cores were assembled into nine separate refitment units (excluding a large number of proximal/distal refits of broken flakes). The fact that a low percentage of the total assemblage could be refit is probably due to a number of factors, including the absence of color variation and other landmarks in the material. However, it may be confidently stated that there are many pieces of the partially reconstructed cores which are missing from the assemblage.

In spite of the small number of refits, several interesting results have emerged from this study. Although the cache assemblage appears quite homogeneous in terms of raw material and technology, it is in fact the result of a variety of technological activities and techniques involving multiple cores. At least four of the refitment units are the result of working different bifacial cores. In one case the core itself, along with seven refittable flakes, was present in the assemblage. In all other instances, it appears that several large flakes were struck from different cores, which were not deposited in the feature. The remaining five refitment units refer to the reduction of single- or multiple-platform cores. In all cases only a few

large flakes from the cores are present, and the cores themselves appear to have been removed, worked, and discarded elsewhere. From these data it appears that the production of large flake blanks was one of the activities responsible for the creation of the cache assemblage. It is not possible to determine from these data whether the large flakes which remain represent rejects, or blanks cached for anticipated future use. The fact that the debris had obviously been gathered into a compact mass and perhaps buried argues for the latter interpretation, however.

Interesting results can be obtained from a comparison of the differential use of heat treated versus nontreated material. The majority of the larger flakes and refitment units is made of untreated Pedernal chert. One refitment unit, derived from a single-platform core, is made of heat treated chert. With few other exceptions, heat treated material appears to have been employed in a somewhat different range of technological activities. Heat treated flakes from the cache are smaller and have a higher percentage of retouched platforms (18 percent) than untreated flakes (14 percent). Heat treated biface flakes were twice as common as untreated biface flakes, while untreated core flakes were twice as frequent as heat treated core flakes. It thus appears that the manufacture and/or renewal of bifacial artifacts, most frequently of heat treated chert, constitutes another activity which contributed to the formation of the buried lithic feature at LA 25328. The few obsidian flakes recovered also seem to derive largely from the manufacture or modification of bifacial formal tools although the sample is too small to produce reliable results.

In sum, the cache of lithic materials at LA 25328 differs strongly from surface assemblages both from this site and from the other sites investigated during this project. This assemblage does not contain materials reflecting any completely novel elements of lithic technology but rather a unique combination of core reduction and tool manufacture elements. The production of large flakes and/or flake blanks of untreated Pedernal chert, using both bifacial and platform-core reduction techniques, is the dominant technological activity represented, but evidence of the manufacture of bifaces and perhaps other formal tools is also present. The total assemblage represents the debris from a variety of stone working activities employing multiple cores and raw materials which appear to have been intentionally concentrated and perhaps buried. The feature was probably constructed in anticipation of future use of the area, either as a generalized cache of potentially usable lithic materials or as a store of large flakes with other material included incidentally. The presence of this kind of feature has several interesting implications for patterns of site use and mobility. However, the lack of relative or absolute chronological control hampers an expansion on the significance of these data. Technologically, the feature is perhaps most similar to the assemblages from Proveniences 8 and 10 at LA 25328, but such a connection is tenuous at best. A large, Cerro del Medio (no hydration rate available) obsidian uniface (Cultural Resources Management Division [CRMD] 741-743) which was included in the feature yielded hydration rims reading 3.25-4.48 microns, which cannot be assigned a date but does indicate probable recycling or breakage of the uniface. Two pieces of Polvadera obsidian debitage from the cache area were dated. CRMD 86-371 from the cache feature dated 1,890 B.P. or A.D. 96, while CRMD 86-789 from N53/E129 but not the feature itself dated 2,604 B.P./618 B.C.

The latest uniface date falls within the Armijo Phase of the Late Archaic Period, but the other two dates indicate En Medio Phase use of items in the cache. If deposit of the cached items occurred over a short period of time, then the latest date would correlate with cache deposit. It is probable that cached items were collected from the surface, so that to some extent older and more recent materials would be combined in the eventual cache deposit.

6.2.7.9 Summary of Lithic Data and Site Occupational History

The 12 provenience units at LA 25328 present a diversity of technological profiles. There are some consistencies, including a predominance of debris relating to postprimary core reduction activities, the dominance of Pedernal chert and Polvadera obsidian as raw materials, and a low relative frequency of casual or expedient artifacts indicative of local processing of nonlithic materials. The major provenience units exhibit considerable variability in the importance of biface manufacture, as opposed to core reduction activities, and the stages of bifacial tool working represented, as well as in the differential use of raw materials. The assemblage from Provenience 1 is dominated by Polvadera obsidian, as well as by debris indicative of primary and secondary core reduction on both obsidian and chert. Provenience 2 is characterized by a somewhat higher frequency of debris tied to biface reduction, as well as by the presence of a third material, silicified sandstone, in significant quantities. The outstanding characteristics of the assemblages from Proveniences 3 and 4 (collection Unit 3) include a relatively high proportion of early and late stage biface manufacturing rejects and a significantly higher proportion of biface working debris in Polvadera obsidian as compared with the more common chert. Proveniences 5 and 6 are, in contrast, characterized by a low frequency of biface working, most of which is probably attributable to renewal rather than manufacture, and the relatively similar treatment of obsidian to chert. Finally, in addition to relatively high surface densities, Proveniences 8, 10, and 11 are characterized by a pattern of differential use of obsidian, chert, and silicified sandstone, which is present in significant quantities only in these proveniences and in the adjoining Provenience 2. Provenience 10 also yielded the only evidence of the use and maintenance of ground stone food processing implements at the site.

The technological data alone suggest that three distinct, functionally and/or chronologically differentiated occupational or activity zones are represented within LA 25328 by 1) Provenience 1, 2) Proveniences 3 and 4, and 3) Proveniences 5 and 6. Based on similarities in assemblage composition and their spatial proximity, it is likely that Proveniences 8 and 10 represent a fourth discrete component within the site. Most of the differences among these four components are technological ones, and all four areas exhibit basic similarities in the range of technological activities represented as well as in the dominance of stone working over other processing activities. The difference in the treatment of various raw materials within and among the various provenience groups is perhaps the most interesting and informative pattern produced by the preceding analyses. First, it shows that the different applications to which a particular raw material is put are not simply a function of qualities inherent in the material itself. For example, Polvadera obsidian may be used to make bifaces in one context and as a source of flakes or tool blanks in another. Similarly, the data indicate that the location and

distribution of the raw material relative to the point of use do not completely condition how it is employed in all contexts but that a variety of other factors, such as patterns of mobility, the use of a particular place, and activity variation, must intervene to produce the kinds of variability which have been observed at LA 25328.

The technological data suggest that the various spatial components at LA 25328 represent discrete chronologically or functionally differentiated occupational episodes, rather than contemporaneous activity areas. The observed patterning does not appear to involve synchronous activity variation. Unfortunately, the projectile point data are not very informative about possible chronological differentiation. Most of the temporally diagnostic artifacts were recovered from outside the established collection units, and there are a number of Late Archaic phases and early Anasazi periods indicated by cross-dating the points found within each unit (see Chapter 8). Both technology (abundant biface working) and typology (lanceolate and palmate dart point) seem to indicate that Proveniences 3 and 4 -- as well as 8, 10, and 11 -- are grossly datable to the later Archaic. The low frequency of biface working in Proveniences 5 and 6 would similarly be consistent with the recent date implied by the presence of a small arrow point. Provenience 1 remains most ambiguous, due to the absence of diagnostic artifacts and the unusual raw material assemblage.

6.2.8 Summary

LA 25328 is an extensive, locally dense lithic scatter consisting of a number of distinct concentrations. A total of 1,105 m^2 of surface collection and the excavation of five test units resulted in the recovery of a large sample of lithics, including diagnostics spanning a considerable portion of the Archaic and Basketmaker Periods. An apparent cache of unretouched lithic materials was also recovered. Because of inundation by Abiquiu Lake, no clear limits could be determined for the southern and western edges of the surface scatter. It is suggested that the site retains substantial and significant research potential.

It is difficult to assign clear boundaries to LA 25328. The site consists of a number of relatively dense concentrations with intervening low density areas. There was a significant drop in artifact densities toward the eastern edges of surface blocks 2 and 5, and no distinct concentrations were noted in this direction. There was a similar drop-off in surface occurrence to the north of block 1 and the road, where the arroyo provided an appropriate boundary. Unfortunately, rising waters had covered most of the western and southern limits of the site, and no clear limits can be assigned to the scatter in these directions.

The diagnostic artifacts recovered from LA 25328 appear to date from a long span of Archaic and possible Basketmaker prehistory in the study area. A large, diverse, and extremely rich assemblage of lithic artifacts was collected from a relatively small surface and subsurface sample. The surface distribution of archaeological materials takes the form of a number of discrete, high density concentrations with intervening areas of lower surface density but possible subsurface deposits. The site appears to have had a

complex depositional and occupational history. Further details on chronology are provided in Chapter 7.

6.2.9 Recommendations

Undeflated deposits to the northeast of the areas investigated require extensive testing, collection, and excavation. The Piedra Lumbre component should be recorded.

6.3 LA 25330

6.3.1 Physiographic Setting

This site is a sparse, uniformly distributed lithic scatter situated on a relatively flat bench on the eastern edge of the flooded Chama River Valley, approximately 1,900 m from the old channel. The site lies immediately northwest of, and upslope from, the canyon bench and tinajas of LA 51698. A steep drop-off is immediately west of the scatter. Water extended up to the edge of this drop-off at the time of this study. The elevation of LA 25330 varies between 6265 and 6285 feet. The site surface slopes gently to the west and southwest, and a number of small, southwest trending, ephemeral, erosional rills cross the site area. Soils are sandy and quite thin and contain numerous fragments of sandstone bedrock. Domestic stock appear to have caused some surface disturbance at the site, mainly through trampling. A pile of dry, cut vegetation was located on the west edge of the site within the western portion of the surface block. A barbed wire fence is located farther to the west, above the steep drop-off.

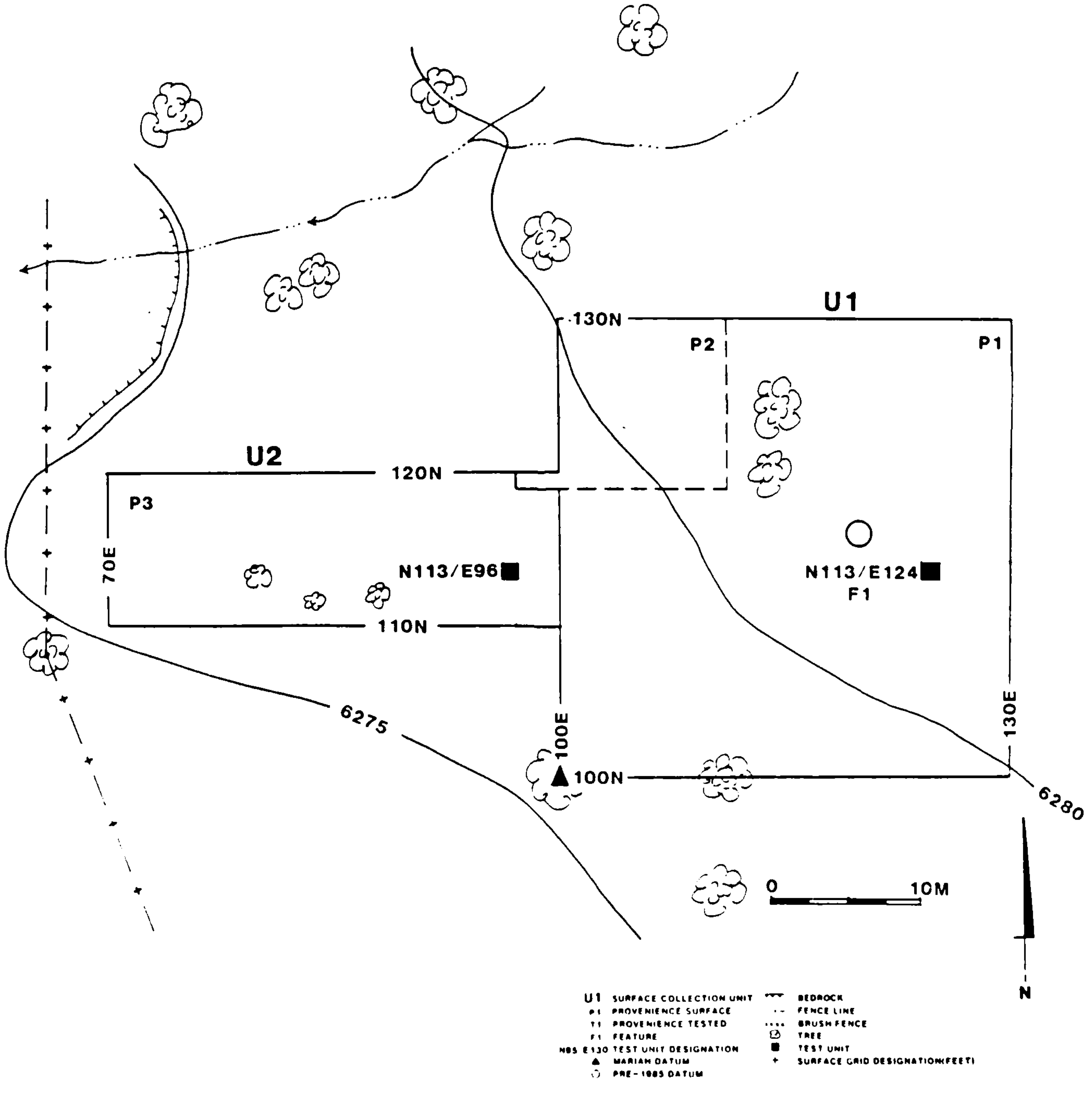
6.3.2 Previous Work

LA 25330 was first located during the SAR (Schaafsma 1976:54, Beal 1980:29,30) survey and was revisited by Nickens and Associates (Reed et al. 1982:58-59) crews. The first visitors to the site described it as a "lithic area" (Schaafsma 1976:54) containing a variety of lithic materials including knives and scrapers. On the Nickens site visitation, two possible fire hearths were mapped, one to the southeast of the site datum and one to the southwest. Both of these possible features, as well as the site stake, were relocated during the present study. Their stake was located at coordinates 116N/120E in the grid system used at the site.

6.3.3 Field Methods

In all, 1,200 m^2 of LA 25330 were subject to intensive (100 percent) surface collection (Figure 6.14). The main surface collection block measured 30 m^2 and was placed to include what appeared to be the area containing the highest overall surface density, along with adjacent low density areas. A 10 x 30 m "arm" extended from this block to the west. This second area was collected in order to monitor decreasing surface densities downslope of the main concentration.

Figure 6.14 LA 25330, Abiquiu Archaeological Study, ACOE, 1989.



6.3.4 Collection Unit

The western limits of the artifact scatter are clearly bounded by the steep drop-off and barbed wire fence: significant decreases in artifact densities occur in this area. Other boundaries are not so easily delineated. The presence of relatively dense concentrations in the southern end of the main surface collection block suggests that the scatter does extend some distance in this direction. Observations made at the time of this investigation indicate that surface densities become extremely low immediately to the north and east of the main block, and it would not be unwarranted to assign site limits just outside of these edges of the block, pending further evaluation of depositional integrity in these areas.

Surface collection at LA 25330 resulted in the recovery of 1,942 artifacts, providing a mean density of approximately 1.5 artifacts/m^2. Three additional lithic artifacts were recovered from the test units. Included in the artifact sample were two projectile point fragments, two cores, two one-hand manos (one whole, one fragmentary), and seven scrapers. The scrapers, which are all large, well-made, and either circular or lozenge-shaped, occur with a much higher frequency here than at any other site investigated in this project. One scraper and one projectile fragment were collected outside of and to the south of the main surface collection block.

LA 25330 exhibits a distribution of surface materials which is somewhat different from most of the other sites investigated. Artifacts appear to be distributed within the main block in the form of small, moderately dense concentrations less than 10 m across, separated by empty areas. It is difficult to distinguish any distinct density trends across the surface although two possible concentrations, with densities of nine to 10 artifacts/m^2, can be perceived in the southwestern and southeastern corners of the main block. A significant drop-off in surface densities occurs toward the end of the western extension of the surface unit; this could be attributable in part to reduced visibility due to the presence of downed vegetation on the surface in this area. Members of the field crew noted that the surface density within individual squares tended to be higher within small erosional features, suggesting that postdepositional movement may have been a significant force in producing the surface patterning observed.

6.3.5 Subsurface Samples and Stratigraphy

Two 1 x 1 m test units (Figures 6.15 and 6.16) were excavated. Table 6.10 lists samples taken. Unit 113N/124E was situated approximately five meters southeast of the site stake, at one of the possible hearth features. The second unit, 113N/96E, was excavated in the center of what appeared to be the second hearth described by survey crews. All fill was screened through 1/4-inch mesh.

Figure 6.15 LA 25330, N113/E124, Feature 1, Top of Level 2, Plan View, Abiquiu Archaeological Study, ACOE, 1989.

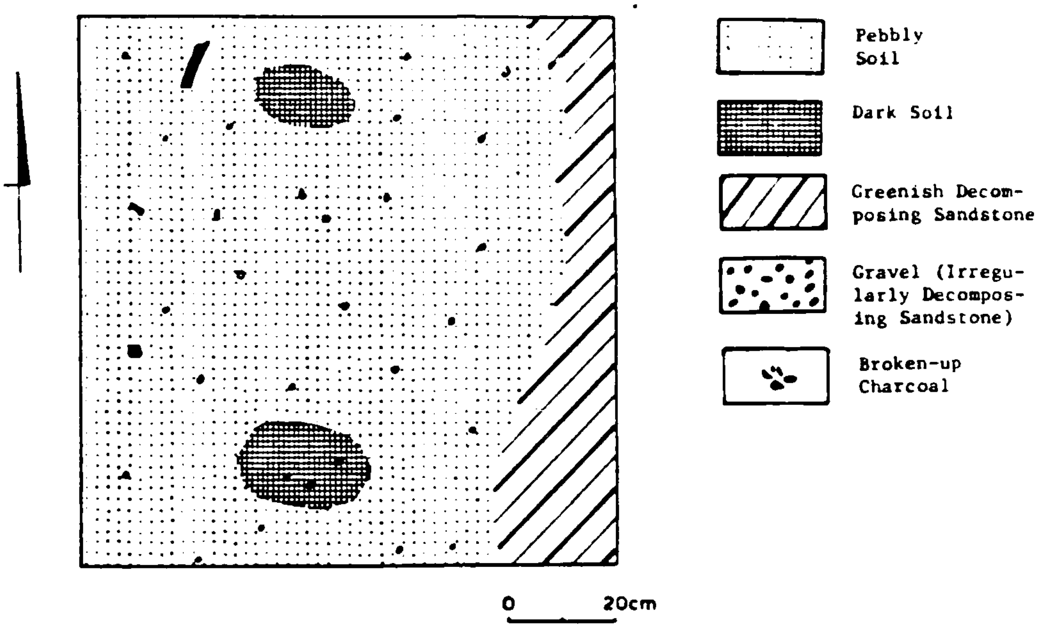


Figure 6.16 LA 25330, N113/E124, Feature 1, North Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

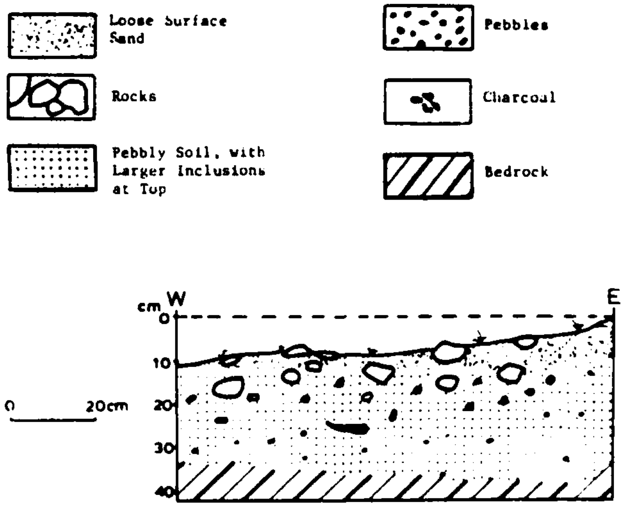


Table 6.10 LA 25330 Samples, Abiquiu Archaeological Study, ACOE, 1989.

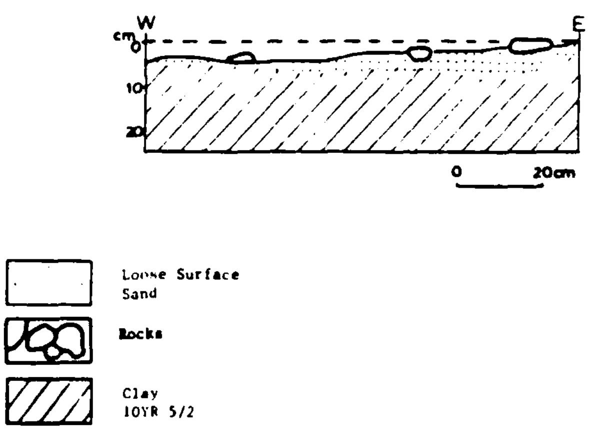
Provenience	Flotation	Pollen	C-14
N113/E96, Level 1	1	1	1
N113/E124			
Level 1	1	--	3[1]
Feature 1, Level 2	1	--	1

1 Combined samples too small to date.

The excavation of test unit 113N/124E resulted in the exposure of a possible fire hearth feature immediately below the loose surface fill. This feature consisted of a semicircular accumulation of sandstone fragments, some of which were fire-reddened, and contained ash-stained soil and numerous tiny flecks of charcoal. The hearth was approximately 80 cm in diameter and lay directly on decaying bedrock. Three flakes were recovered from the fill.

Excavation of test unit 113N/96E (Figure 6.17) revealed that the second possible hearth area represented a natural feature. This area had been marked on the surface by a large area of extremely dark soil which appeared much like ash or charcoal-stained fill. Upon excavation, it was discovered that this staining was associated with a shallow deposit of dark clay, possibly a decay product of the local bedrock. No charcoal, ash, or artifactual materials were noted during excavation, and excavation was discontinued at a depth of between 24 and 34 cm below the surface, within the clay layer.

Figure 6.17 LA 25330, N113/E96, North Wall Profile, Aibquiu Archaeological Study, ACOE, 1989.



6.3.6 Ceramics, Bone, Historical Artifacts

Several concentrations of fragmentary, possibly burned, bone were noted in the areas of site LA 25330 studied; seven pieces were collected from 129N/104E. These bones proved to be scatological remnants of *Lepus* spp. (jackrabbit) proximal tibia and posterior calcaneum, as well as shaft splinters entirely consistent with the *Lepus* spp. identifiable fragments. All appear digested, and all but one have been severely weathered by surface thermal and ultraviolet exposure. All pieces probably relate to a single fecal deposit, almost certainly by a canid; hence, the archaeological relevance of these items is questionable or nil.

Neither ceramics nor historic artifacts were encountered at LA 25330.

6.3.7 Rough Sort and Detailed Lithic Analysis

LA 25330 represents a lithic scatter with one hearth feature. Two surface units were collected on the site. Unit 1 measured 30 x 30 m and was placed over the higher density portion of the site. Unit 2 represented a 10 x 30 m western extension from Unit 1 over a less dense lithic scatter.

6.3.7.1 Lithic Analysis

The distribution of lithic artifacts and various material types was examined in both units to determine if activity areas could be identified; this exercise resulted in the identification of two proveniences in Unit 1. Provenience 2 is a concentration of lithic debris measuring 10 x 13 m in grids 119-129N to 97-110E. Provenience 1 represents the remainder of the surface of Unit 1. Provenience 3 represents the entire remaining surface of Unit 2. Two test pits were placed in association with the two suspected hearth features. Three flakes were removed from 113N/124E, which proved to be a hearth; no artifacts were recovered from 113N/96E, which probably was not a hearth.

A total of 1,908 artifacts was recovered from LA 25330. These artifacts included 1,906 pieces of chipped stone and two pieces of ground stone. Ceramic and historic artifacts were not recovered. Burned faunal remains were observed. Flakes and small angular debris represented 97 percent (1,861) of the assemblage (Table 6.11). Other chipped stone artifacts represented only three percent of the assemblage and included 21 bifaces, 10 unifaces, two projectile points, one drill, 10 cores, and one piece of small angular debris. One noncultural item is included in the table.

A detailed analysis was conducted on samples drawn from Unit 1 on LA 25330. These samples were selected on the basis of the field distribution maps and included four units of varying sizes in each quadrant of Unit 1. A total of 153 chipped stone artifacts underwent the detailed analysis in Provenience 1 while 44 items were further analyzed in Provenience 2. The discussion of the rough sort data in each provenience is followed by an examination of additional information provided by the detailed analysis.

Table 6.11 LA 25330 Tool Group Material Type Frequencies for Entire Site (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type									
Material Type	Biface	Cores	Drill	Flakes	Large Angular Debris	Miscel-laneous	Projec-tile Point	Small Angular Debris	Uniface	Total
Alibates-Like	--(--)	--(--)	--(--)	2(50)	--(--)	--(--)	--(--)	1(25)	1(25)	4(<1)
Brown Jasper	1(14)	--(--)	--(--)	6(86)	--(--)	--(--)	--(--)	--(--)	--(--)	7(<1)
Fossiliferous Cream Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1(<1)
Jemez Obsidian	--(--)	--(--)	--(--)	12(92)	--(--)	--(--)	1(8)	--(--)	--(--)	13(1)
Miscellaneous Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1(<1)
Morrison Green Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1(<1)
Morrison-Miscellaneous Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1(<1)
Moss Jasper	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1(<1)
Nacimiento Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1(<1)
Pedernal Chert	15(1)	8(1)	1(<1)	1,435(93)	3(<1)	1(<1)	1(<1)	74(5)	6(<1)	1,544(81)
Polvadera Obsidian	3(1)	1(<1)	--(--)	278(98)	--(--)	--(--)	--(--)	1(<1)	2(1)	285(15)
Quartzitic Sandstone	1(3)	--(--)	--(--)	26(90)	1(3)	--(--)	--(--)	1(3)	--(--)	29(2)
Quartzite	--(--)	--(--)	--(--)	8(100)	--(--)	--(--)	--(--)	--(--)	--(--)	8(<1)
Vitrophyre	--(--)	1(8)	--(--)	11(92)	--(--)	--(--)	--(--)	--(--)	--(--)	12(1)
Total	20(1)	10(<1)	1(<1)	1,784(93)	4(<1)	1(<1)	2(<1)	77(4)	9(<1)	1,908(100)

Heat treatment occurred on Pedernal chert but was not observed on any other material type. The frequency of heat treated materials on LA 25330 is lower than other sites in the study area. Only 51 percent (795 artifacts) of the Pedernal chert was heat treated. Among the heat treated artifacts, 86 percent (687) exhibited successful treatment while only 14 percent (108) showed evidence of unsuccessful heat treatment. The detailed analysis provided data on whether cores or flakes were treated. These data indicate that flakes were heat treated in some cases (four artifacts). The majority of artifacts did not exhibit thermal surfaces on both sides indicating their treatment as cores rather than as flakes.

Table 6.12 summarizes the distribution of heat treatment over various artifact types. Again, the assemblage on LA 25330 is different from other sites in the study area. Where most sites exhibit very high percentages of heat treatment among biface flakes and formal tools, only 62 percent (60 artifacts) of the biface flakes from LA 25330 were heat treated. An examination of formal tools indicates that early bifaces were manufactured from both heat treated and nontreated chert. Among core flakes, 43 percent were treated (234 artifacts) while 57 percent remained nontreated (373 artifacts). When success of heat treatment is examined, between 92 percent and 100 percent of

the bifaces and biface flakes exhibit successful treatment; among core flakes 75 percent were successfully heat treated.

Table 6.12 LA 25330 Heat Treatment for Chert to Artifact Type Frequencies for Entire Site, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total Treated	Successful	Unsuccessful	Successful Core	Successful Flake	Total
Biface Flake	10	60	58	--	2	--	70
Biface	3	13	10	1	1	1	16
Multiplatform Core	1	5	4	1	--	--	6
Single-Platform Core	2	--	--	--	--	--	2
Core Flake	241	284	202	70	10	2	525
Drill	--	1	1	--	--	--	1
Heat Spall	--	1	--	1	--	--	1
Large Angular Debris	--	3	2	1	--	--	3
Pressure Flake	9	9	--	--	9	--	18
Small Angular Debris	42	32	15	17	--	--	74
Unidentified Flake	435	372	317	17	37	1	807
Unifacially Re-touched Flake	3	12	11	--	1	--	15
Uniface	3	3	3	--	--	--	6
Total	749	795	623	108	60	4	1,544

6.3.7.2 Provenience 1

Provenience 1 represents the general surface scatter in Unit 1. A total of 1,203 chipped stone artifacts and two pieces of ground stone was recovered. The material types represented in this assemblage are similar to the majority of sites in the study area. Pedernal chert made up 76% (916 artifacts) of the assemblage and Polvadera obsidian 19% (232 artifacts). Twenty artifacts (two percent) were manufactured from local quartzitic sandstone. The majority of other debris (25 artifacts) represented eight local material categories. Nonlocal materials included one uniface that was manufactured from an Alibates-like material that probably outcrops on White Mesa near San Ysidro, New Mexico, approximately 60 miles south-southwest of the project area; a flake manufactured from Nacimiento chert, which occurs in the Sierras Nacimientos approximately 25 miles west of the project area; and five flakes of vitrophyre basalt with the closest source at San Antonio Peak, about 50 miles north-northeast of the project area.

The detailed analysis appears to indicate the resharpening of both bifacial and unifacial tools. Use was identified on unidirectionally (one

platform) and bidirectionally retouched platforms (one platform). Evidence provided by the formal tools indicates that bifacial tool use was minimal.

Six cores found in Provenience 1 indicate that both random and systematic core reduction occurred. All cores were manufactured from Pedernal chert. Two were identified as single platform cores, and four were multiplatform cores. No exhausted cores were recovered.

A total of 26 formal tools was recovered from Provenience 1 (Appendix F). The majority of these was manufactured from Pedernal chert (18 artifacts). The Pedernal artifacts included early and late bifaces as well as scrapers. The six obsidian formal tools represented early bifaces, late bifaces, and unifaces also. A drill and an early preform were manufactured from quartzitic sandstone, an end scraper from local chert, and a uniface from an Alibates-like chert.

The formal tools that were recovered from Provenience 1 included 15 bifaces (five blanks, eight early bifaces, one late biface, and one undetermined biface), seven unifaces, two end scrapers, one projectile point, one drill, and one flake with extensive unidirectional marginal retouch. The projectile point was an arrow point, possibly a Thoms (1977) type 34 Parallel-sided Asymmetrical Tang or a type 35 Tesuque Narrow Base (Figure 8.1B).

The examination of heat treatment discussed earlier indicated that the assemblage on LA 25330 exhibited a relatively high percentage of nontreated biface flakes and bifaces. The formal tools indicate that early biface manufacture occurred on nonheat treated materials as well as on treated materials. Two blanks (an early biface and a uniface) lacked evidence of heat treatment, while three additional biface blanks exhibited successful heat treatment. These data indicate heat treatment and nonheat treatment strategies. It is difficult, however, to determine if both strategies occurred simultaneously or if they represent different episodes separated by time. En Medio Phase and Late Developmental Period occupations predominated at this site, based on obsidian and cross-dated point types (see Chapter 8). The multicomponent and spatially clustered dates for this site make it impossible to determine if the two strategies are temporally distinct.

One projectile point and one uniface were collected near, but outside of, the Provenience 1 collection unit. Both were manufactured from Pedernal chert. The projectile point was located in 89N/126E. It was a whole Cochiti Straight-Base/type 15 point (Figure 8.6H), but completedness (see Chapter 5) could not be identified. The uniface was completed and recovered from 123N/142E.

Scraping activities were indicated by expedient flake tools and marginally retouched flakes. Expedient tool use was represented by five flake tools with unidirectional wear; four of these were manufactured from Pedernal chert and one from Polvadera obsidian. Nine tools with unidirectional marginal retouch were also recovered. Seven of these were manufactured from Pedernal chert and one from Polvadera obsidian. These artifacts provide further evidence that this location was used for scraping activities. Cutting activities were not represented. Because no utilized flakes were recovered from the

detailed sample, it was not possible to determine if scraping activities represent soft or hard wear.

Ground stone recovered from this location included a whole one-hand mano manufactured from quartzite, and a one-hand mano fragment manufactured from quartzitic sandstone.

The assemblage of formal tools recovered from Provenience 1 on LA 25330 provides valuable information in addition to other data about site function. These tools not only indicate that formal tool manufacture occurred, but that although bifacial and unifacial tools were manufactured, little evidence of bifacial tool use exists. It appears that the completed bifacial tools manufactured at the site were taken to another location for use. The activities performed at the site included scraping, drilling, and grinding. The formal tools also indicate that early biface manufacture was carried out on both heat treated and nonheat treated cherts.

6.3.7.3 Provenience 2

Provenience 2 is a 10 x 13 m lithic concentration composed primarily of Pedernal chert located in Unit 1. A total of 456 artifacts was recovered. These included 452 flakes and pieces of small angular debris, two bifaces, and two cores.

Ninety-four percent (427 artifacts) of the assemblage was Pedernal chert. Polvadera obsidian comprised only three percent (12 artifacts). The other materials represented in this area are similar to the low frequency materials identified throughout Unit 1. The assemblage recovered from this area represents more limited artifact variability. In addition, the lack of unifacial tools is clearly different from Provenience 1.

Two cores -- an exhausted multiplatform Polvadera core and a multiplatform Pedernal core -- were recovered. Both exhibit a random core reduction technique.

An examination of use and preparation on retouched platforms indicates that resharpening occurred. No evidence of use or preparation was identified during the detailed analysis so it was not possible to determine if bifacial or unifacial tools were resharpened. The manufacture of both bifacial and unifacial tools is indicated by Pedernal biface flakes (15) and uniface flakes (four). Two Polvadera biface flakes were also recovered.

Further evidence of formal tool manufacture can be seen in the formal tools recovered from this area. Two uncompleted biface fragments (one preform and one early biface) were identified. Both were manufactured from Pedernal chert; the blank lacked evidence of heat treatment, and the early biface exhibited successful heat treatment. Again, dual heat treatment strategies are indicated.

The lack of similarity between Provenience 2 and Provenience 1 is further illustrated by the absence of evidence of more expedient tool use. This provenience did not produce any marginally retouched or expedient tools.

The lithic concentration set aside as Provenience 2 clearly indicates the formal tool manufacture of Pedernal chert. The materials reduced in this area of the site lacked cortex, further suggesting that prepared cores were involved. Unlike Provenience 1, no evidence of use activities is indicated in this area. The assemblage character is different from the rest of the surface distribution in the unit and may represent an isolated reduction episode occurring after the background lithic scatter was deposited.

6.3.7.4 Provenience 3

Provenience 3 (Unit 2) represents a collection unit placed over a lower density lithic scatter adjacent to Unit 1. The artifacts recovered included 245 flakes and pieces of small angular debris, three bifaces, one uniface, and two cores.

The lithic assemblage recovered from Provenience 3 appears to represent a lower density area that is similar to the overall scatter described in Provenience 1. The proportion of Pedernal chert (80 percent, 199 artifacts) and Polvadera obsidian (16 percent, 41 artifacts), as well as the artifact variability, represents similar material selection and functional variability.

Two cores were recovered -- a basalt single-platform core and a Pedernal multiplatform core. Similar cores were identified in Provenience 1.

An examination of flake types and formal tools represented indicates an emphasis on bifacial tool manufacture. Ten biface flakes (eight Pedernal and two Polvadera) were recovered. Formal tools included cores, bifaces, and one end scraper. Two Pedernal biface fragments represented early stages of manufacture, while the Polvadera biface fragment represented later stages. These data are similar to those of Provenience 1. Both areas indicate all stages of reduction and formal tool manufacture, both exhibit evidence of scraping activities, and both lack evidence of bifacial tool use.

6.3.7.5 Lithic Analysis Summary and Site Activity Areas

LA 25330 appears to represent a generalized lithic scatter (Proveniences 1 and 3) with discrete Pedernal concentration (Provenience 2). Overall assemblage composition may indicate that the Pedernal concentration is superimposed on the general background lithic scatter. The general lithic scatter evidences all stages of reduction and tool manufacture for Pedernal chert and Polvadera obsidian. Both bifacial and unifacial tool manufacture is indicated; however, bifacial tool use is not represented. Tool use on the site was dominated by scraping activities. Additional activities are indicated by a drill and two manos.

Provenience 2 represents secondary reduction and tertiary formal tool manufacture of Pedernal chert. Primary decortication did not occur in this area. The lack of evidence of tool use suggests that this area is strictly a reduction and manufacturing location.

6.3.8 Chronology

Two projectile point fragments were recovered from LA 25330. One is a large, corner-notched dart point manufactured of chert: it is heavily reworked. The second is a fragment of a small, corner-notched arrow point of obsidian. The first would probably be attributed to a late Archaic or early Basketmaker Phase while the second is probably associated with the pre-En Medio Period. The large scrapers, while not temporally diagnostic, seem to be associated with some preceramic period. The C-14 sample was too small to produce a date. Chapter 7 gives more details on chronology and site occupational history.

6.3.9 Summary

LA 25330 is a moderate to light density surface lithic scatter on a flat bench or terrace. Investigation of the site involved a total of 1,200 m^2 of surface collection and the excavation of two test units. The site contained at least one surficial prehistoric hearth, which was excavated. The site also yielded a distinctive artifact assemblage, with unusually high frequencies of well-made scrapers.

6.3.10 Recommendations

The scatters to the north and east of the site boundaries should be mapped and collected.

6.4 LA 25333

6.4.1 Physiographic Setting

LA 25333 is situated on the crest of a low ridge within an area of relatively gentle relief along the eastern slope of the Chama River Valley upland. The site lies approximately 1.6 km northeast of the old riverbed, at an elevation of approximately 6270 feet. Soils appear to be deflating or eroding away over the western one-third of the site area, and sandstone/shale bedrock is exposed in places. The site surface slopes away to the west in this area; several small rills or incipient drainages run to the west and southwest from around the area of the site stake. The eastern and northern portions of LA 25333, like the surrounding landscape, are relatively level and are covered with relatively stable sandy soils.

6.4.2 Previous Work

This site was originally located and revisited during the SAR (Schaafsma 1976:54, Beal 1980:34-35) surveys and was described at the time as a small, diffuse artifact scatter with fragments of one or more Pueblo IV ceramic vessels. Reinspection by Nickens and Associates (Reed et al. 1982:60-61) resulted in the identification of a possible hearth to the southwest of the site stake, along with the charcoal concentration described in section 6.4.3. A greater variety of artifacts, including ground stone, was noted in the third visitation, as were black-on-white, black-on-gray, and buff sherds. Nickens' crew also noted an extensive background lithic scatter.

6.4.3 Field Methods

The field crew for this project was unable to locate the possible hearth shown to the southwest of the site stake on Nickens' field map. Nickens' map shows the feature within a small drainage, and it has possibly been eroded away. In addition, the sandstone bedrock is reddish in color, and isolated chunks of this material might have been mistaken for the remains of a hearth. The charcoal concentration described by Nickens' crew was located. The freshness of the charcoal, the lack of any soil deposition on or around it, and the presence of small wood chips and a stake produced by a metal axe indicated that the feature was of relatively recent origin. It was concluded that this feature did not warrant further testing.

6.4.4 Collection Units

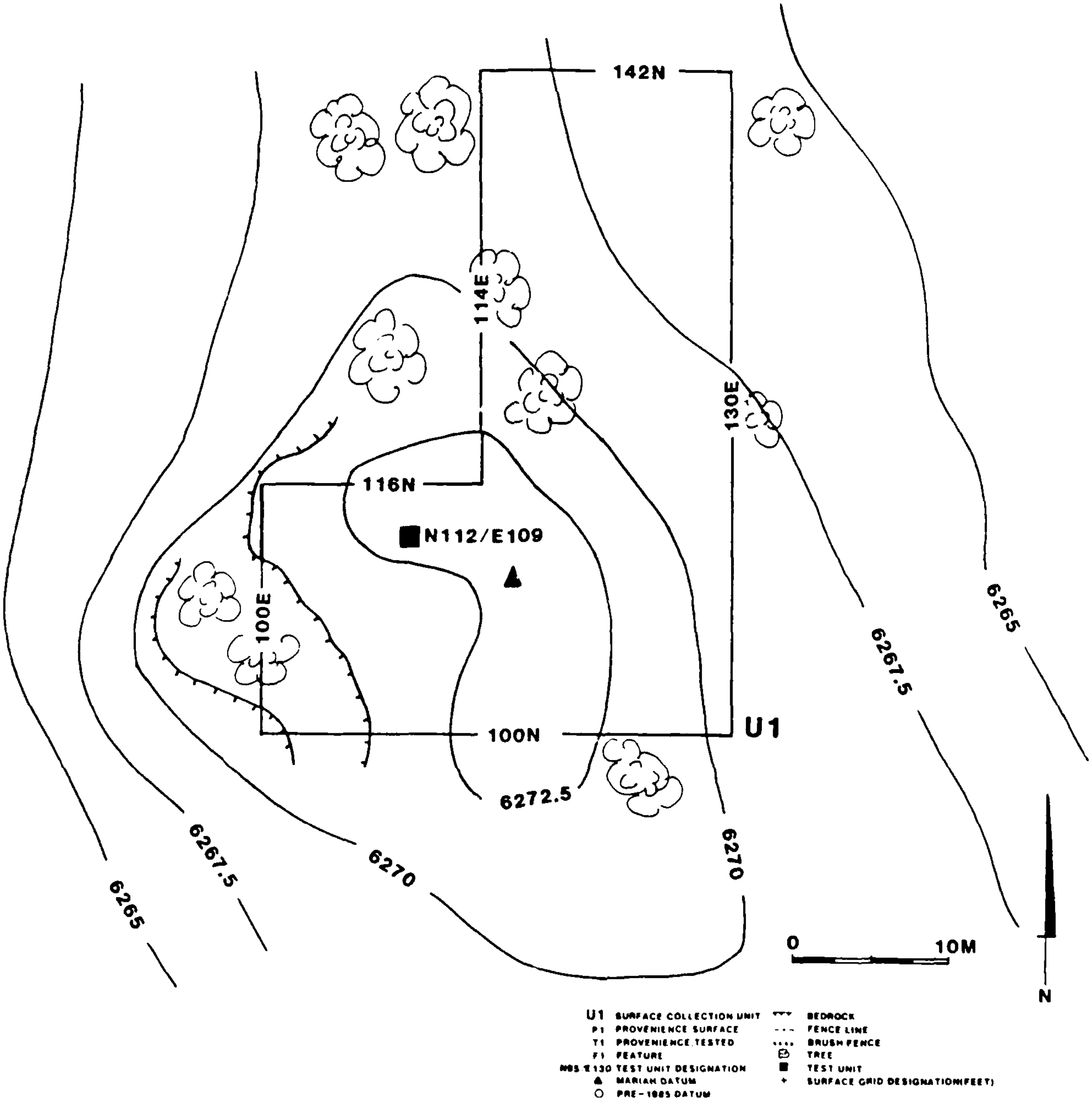
A total of 900 m^2 of LA 25333 was subject to intensive (100 percent) surface collection. The collection unit consisted of a single "L"-shaped block, 14 x 16 m and 42 x 16 m in size (Figure 6.18). The western extension of this block was placed to include the obvious concentration of ceramics to the west of the site stake. The northern portion was intended to include a second possible concentration to the northeast. The overall placement of the surface collection was designed to monitor the distribution of artifacts within both relatively dense concentrations and the intervening, low density areas. This collection strategy also allowed the sampling of areas with both stable and eroding or degrading soil cover. The original site stake is located at grid coordinates 1[illegible]0N/116E within the surface collection area.

A total of 410 artifacts was collected from LA 25333. The artifact sample includes 274 ceramic sherds, 134 lithics, and two pieces of ground stone. All artifactual material was collected from the surface. Three specimens -- one mano and two projectile point fragments -- were encountered outside the intensively collected area and were plotted individually.

Surface densities within the intensively collected area ranged from zero to 39 specimens/m^2. The latter figure is somewhat misleading in that it reflects areas where a large number of very small ceramic fragments was recovered; these are apparently pieces of a few much larger sherds which had been crushed in place. Mean surface density was approximately 0.5 specimen/m^2.

The initial impression of two distinct surface concentrations was confirmed by controlled surface collection. One concentration, consisting of ceramics and a small number of lithics, was situated in the western end of the surface collection block, immediately west of the site stake, where the highest surface densities on this site were encountered. A very diffuse scatter of lithics was also located immediately south and southwest of the site stake. This lithic scatter may overlap spatially with the ceramic scatter. The second major surface concentration was located within the northernmost 12 to 16 m of the northern portion of the surface collection block. This concentration is larger but less dense than the ceramic scatter; surface densities ranged from zero to seven artifacts/m^2.

Figure 6.18 LA 25333, Abiquiu Archaeological Study, ACOE, 1989.



The two major surface concentrations differed not only in their densities and locations but in their contents. To the west of the site stake, surface materials consisted almost entirely of ceramics. The north concentration was composed entirely of lithics and ground stone, including two projectile point fragments and two manos. This pattern suggests that the site may include at least two functionally, temporally, and/or depositionally distinct prehistoric or protohistoric components. A third, much more recent historic component is represented by historic ceramics, surficial charcoal concentration, and axe-cut wood fragments.

As discussed above, the surface collection area did not extend beyond the boundaries of the observable surface scatter at LA 25333 in all directions. Major "falloffs" in surface density were monitored along the southeastern edges of the surface block and also to the northeast of the site stake. The sherd scatter may extend beyond the southwestern edge of the block although a major break in slope suggests that materials lying in that direction are probably redeposited. The north concentration appears to extend well beyond the boundaries of the collection block to the north and northeast as no decrease in surface densities within the collection unit was observed in these directions.

A single 1 x 1 m test unit was excavated at LA 25333. This unit was located west-northwest of the site stake, at grid location 112N/109E. As there appeared to be little chance of productively investigating previously documented surface features, the test unit was chosen to evaluate observations made in the course of the surface collection. The test unit was located just to the northwest of, and uphill from, a dense surface concentration of sherds. Testing was initiated in this location in order to locate either in situ deposits or features which might have been the source of these ceramics, which were presumed to have experienced some degree of downslope movement from their original locus of deposition.

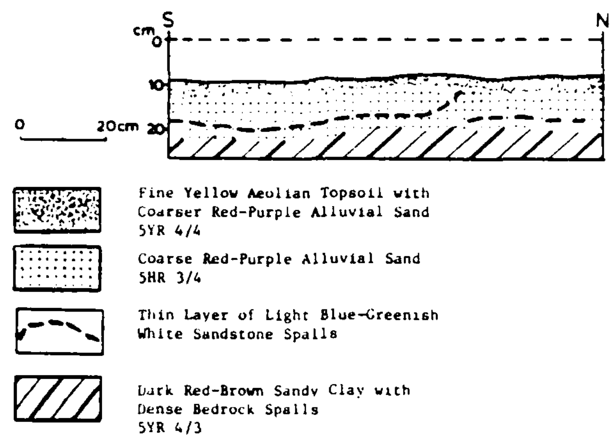
6.4.5 Subsurface Samples and Stratigraphy

The test pit yielded neither artifactual materials nor charcoal, and no cultural layer or feature was encountered. Materials were screened through 1/4-inch mesh. Table 6.13 provides information on samples. The unit was excavated to a depth of between 15 and 18 cm. Excavation was discontinued when solid sandstone bedrock was encountered. Both decaying sandstone clasts and sand of possible aeolian origin were major components in the fill (Figure 6.19).

Table 6.13 LA 25333 Samples, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
N112/E109, Level 2	1	1	--

Figure 6.19 LA 25333, N112/E109, Base of Level 2, West Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



6.4.6 Rough Sort Lithic Analysis

LA 25333 consists of a concentrated ceramic scatter and a diffuse lithic scatter that do not appear to be associated with each other. An "L"-shaped collection surface unit (900 m^2) was placed to encompass lithic and ceramic distributions.

Lithic materials within the ceramic distribution were examined to determine if they were similar to other lithic materials recovered from the site. The character of the ceramic concentration suggested that the pot break occurred against the background lithic scatter and therefore was unassociated. A total of 10 lithic artifacts was recovered from this area of the site. Because assemblage character was similar, the entire lithic assemblage is discussed as a single surface distribution.

One hundred and thirty-six lithic artifacts were recovered from the surface of LA 25333. These artifacts included 134 chipped stone artifacts and two pieces of ground stone.

Table 6.14 describes the chipped stone artifacts that were recovered. Most chipped stone artifacts were flakes and small angular debris (123, 92 percent). Other artifacts included five diagnostic and undiagnostic projectile points, one biface, one uniface, three cores, and two pieces of large angular debris.

LA 25333 exhibited greater material variability than other sites in the study area. Where most sites only exhibit large amounts of Pedernal chert and Polvadera obsidian, LA 25333 exhibited higher frequencies of fossiliferous tan chert (19 artifacts, 14 percent) and quartzitic sandstone (16 artifacts, 12 percent). Pedernal chert comprised 51 percent (68 artifacts) of the assemblage while Polvadera obsidian made up only 16 percent (22 artifacts).

Table 6.14 LA 25333 Artifact Type to Material Type Frequencies for Entire Site (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACCE, 1989.

	Artifact Type						
Material Type	Cores	Flakes	Large Angular Debris	Projectile Point	Small Angular Debris	Uniface	Total
Brown Jasper	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1(1)
Fossiliferous Tan Chert	1(5)	18(95)	--(--)	--(--)	--(--)	--(--)	19(14)
Jemez Obsidian	--(--)	1(50)	--(--)	1(50)	--(--)	--(--)	2(1)
Miscellaneous Chert	--(--)	3(100)	--(--)	--(--)	--(--)	--(--)	3(2)
Morrison Green Chert	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1(1)
Nacimiento Chert	--(--)	--(--)	--(--)	--(--)	--(--)	1(100)	1(1)
Pedernal Chert	1(1)	59(87)	2(3)	2(3)	4(6)	--(--)	68(51)
Polvadera Obsidian	--(--)	20(91)	--(--)	2(9)	--(--)	--(--)	22(16)
Quartzitic Sandstone	1(6)	14(88)	--(--)	--(--)	1(6)	--(--)	16(12)
Vitrophyre	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1(1)
Total	3(2)	118(88)	2(1)	5(4)	5(4)	1(1)	134(100)

Most non-Pedernal and nonobsidian materials used in the study area could have been acquired from the abundant gravel sources in the vicinity of the sites. The tan fossiliferous chert, however, was apparently recovered from a Permian outcrop, the Cutler Formation, which occurs near the bottom of the Rio Chama gorge below Abiquiu Dam, along the west wall of Red Wash Canyon and Arroyo del Cobre, and near the headwaters of the Rio Puerco (Whatley and Rancier 1986:5-11). The nearest outcrop is estimated as 6 km distant from LA 25333.

The remaining material types represented on the site are locally available. Seven artifacts were manufactured from four local materials. A single uniface was manufactured from Nacimiento chert, and one flake from vitrophyre basalt, probably originating from San Antonio Peak.

LA 25333 exhibited evidence of heat treatment on fossiliferous tan chert (Table 6.15) as well as Pedernal chert. This represents the only assemblage encountered that exhibited clear evidence of the heat treatment of a material other than Pedernal chert. Eighty-four percent of the fossiliferous tan chert exhibited heat treatment (16 of 19 artifacts), and all 16 items were successfully treated. When reduction is examined, this assemblage clearly represents primary decortication suggesting that an unprepared core was heat treated. Fossiliferous tan chert is one of the few materials encountered in this study that was not recovered from one of the numerous river gravels that occur around the Abiquiu area. Cortex on this material indicates that it was quarried from the source. This material was selected over the abundant, readily

available local materials and transported to the site. The process of favored material selection may contribute to the fact that this is the only other material class that exhibits clear evidence of heat treatment. The lack of unsuccessfully heat treated debitage may indicate that the tan chert was heat treated at another location and brought to the site as a heat treated raw material.

Table 6.15 LA 25333 Heat Treatment to Artifact Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None		Total Treated		Successful		Unsuccessful		
	#	%	#	%	#	%	#	%	Total
Multiplatform Core	--	--	1	100	1	100	--	--	1
Core Flake	11	21	42	79	29	69	13	31	53
Large Angular Debris	--	--	2	100	--	--	2	100	2
Projectile Point	--	--	2	100	2	100	--	--	2
Small Angular Debris	1	25	3	75	2	67	1	33	4
Unidentified Flake	--	--	6	100	5	83	1	17	6
Total	12		56		39		17		68

The Pedernal chert assemblage exhibited evidence of heat treatment on 76 percent of the artifacts. Of these, only 22 (56 percent) were successfully heat treated. The high percentage of unsuccessful heat treatment indicates that heat treatment occurred at or near the location.

An examination of heat treatment and artifact type indicates that 79 percent of core flakes were heat treated. Of these, 69 percent were successfully treated. There was no evidence of formal tool manufacture within the Pedernal chert material class.

LA 25333 exhibited greater diversity in reduction, as well as material selection, than other sites in the study area. Unlike most other sites examined, the assemblage of Pedernal chert indicated primary decortication and secondary reduction but lacked evidence of formal tool manufacture. The fossiliferous tan chert assemblage was clearly primary (64 percent cortex) with some evidence of secondary reduction, as was the assemblage of quartzitic sandstone (56 percent cortex). None of these assemblages exhibited evidence of formal tool manufacture.

The Polvadera obsidians were the only material class where biface flakes (three flakes) with retouched platforms, indicating formal tool manufacture, were identified. This assemblage also exhibited evidence of primary and secondary reduction.

Three cores were also recovered. One fossiliferous tan chert tested core, a Pedernal multiplatform core, and a quartzitic sandstone core/ground stone sharpener (pecker) were found.

Although the reduction sequences indicated by flake type and platform types lack evidence of the manufacture of Pedernal formal tools at the site, the presence of one incompleted uniface (Appendix F) suggests that this tool was manufactured at the site. An additional completed Pedernal projectile point fragment was recovered from the unit. Completed and incompleted Polvadera obsidian point (one), uniface (one), and flake with extensive marginal retouch (one) artifacts were recovered, supporting other evidence that Polvadera obsidian formal tool manufacture occurred at the site. One completed Jemez obsidian projectile point basal fragment was also recovered. The lack of debitage manufactured from this material type suggests that the point was manufactured at another location. An incompleted Nacimiento chert uniface fragment was the only artifact that represented this material class.

Two additional projectile point fragments were collected outside of the collection unit. One was a basal fragment of Polvadera obsidian described as palmate triple-notched; the other was a Pedernal, corner-notched dart/arrow point.

Expedient tool use was indicated by a single Pedernal flake with unidirectional wear. Use wear was not identified on flakes from other material classes. One Pedernal flake exhibited unidirectional marginal retouch also indicating scraping activities.

Additional functional diversity is indicated by two one-hand manos. One was manufactured from coarse-grained quartzite and measured 124 x 94 x 40 mm. The other was manufactured from coarse quartzitic sandstone and measured 115 x 94 x 42 mm.

The lithic assemblage that was recovered from LA 25333 was different from most other site assemblages in material selection and reduction sequences. This assemblage clearly indicates all reduction and tool manufacturing stages for Polvadera obsidian; however, the reduction of Pedernal chert, fossiliferous tan chert, and quartzitic sandstone is limited to primary decortication and secondary reduction. In addition, a number of formal tools may have been brought to the site as complete tools. Tool types represented on the site indicate that scraping tools were manufactured at the site and that grinding activities occurred.

6.4.7 Ceramics, Bone, Historic Artifacts

All of the 274 sherds collected from LA 25333 proved to be Powhoge Polychrome, as was suspected in the field. No whiteware or grayware sherds were present in collected units or observed on the site, contrary to earlier reports, although Reed et al. (1982:60) report collection of "one small black-on-white jar sherd" encountered in a collection unit. Historic artifacts were restricted to axe-cut wood and recent charcoal, none of which was collected.

6.4.8 Chronology

The points found outside the surface collection block include the base of a corner-notched obsidian dart/arrow point (Figure 8.1A), and a second side- and basally-notched dart point of chert (Figure 8.6C). A shallow, side-notched arrow point was collected within the northern arm of the grid. The 293 sherds represent a broken Powhoge Polychrome olla. Large Powhoge Polychrome vessels like the one found at LA 25333 date from A.D. 1700 to 1900; they were regularly used as storage vessels for grains (Dick 1968). No black-on-white or black-on-gray sherds were seen. Chapter 7 gives more details on chronology.

6.4.9 Summary

LA 25333 is a sparse to moderately dense scatter of late prehistoric and historic lithic and ceramic artifacts. Investigation of the site included controlled, 100 percent collection of 900 m^2 of surface area and the excavation of a single 1 x 1 m test unit. All artifactual material recovered came from the surface. The site consists of two spatially and artifactually distinct surface concentrations. A third, recent historic component is also represented by historic ceramics, a surficial charcoal concentration, and axe-cut wood fragments.

6.5 LA 51698

6.5.1 Physiographic Setting

This multiple-component site is located 1,950 m from the Chama River at elevations ranging from 6250 to 6270 feet. The site is in the bottom and northern bench of a small canyon. A west flowing drainage bounds the site to the south; natural sandstone tanks are present southeast of the area. The northern boundary of the site is marked by a low, talus-covered, sandstone slope. Deposits in the site area include aeolian and colluvial sands which are crosscut by several shallow, southwest trending erosion channels.

6.5.2 Previous Work

This site was first recorded by MAI crews.

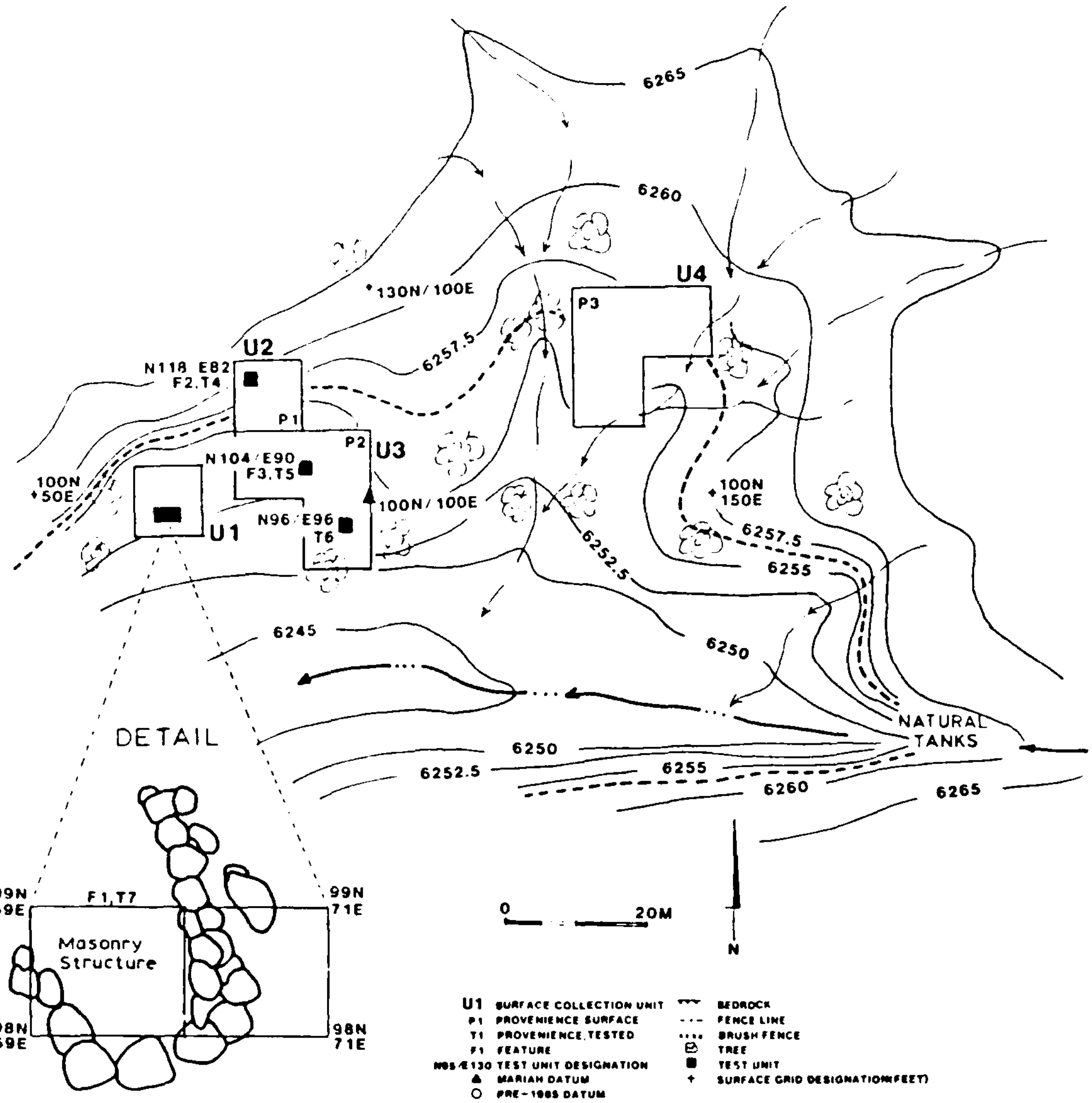
6.5.3 Field Methods

This site was on the immediate edge of the rising Abiquiu Lake. An examination of the site area suggested a diffuse lithic scatter with a sandstone structure and two possible hearth areas in an 85 x 35 m area. An 800-m^2 surface collection was conducted in four areas of the site (Figure 6.20).

6.5.4 Collection Units

Collection Unit 1 consisted of a 10 x 10 m area and was located around the structure (Feature 1). Collection Unit 2, another 10 x 10 m unit, was located on the sandstone talus slope around hearth Feature 2. Collection Unit 3 was a 300-m^2, "L"-shaped area located around and to the southeast of hearth

Figure 6.20 LA 51698, Abiquiu Archaeological Study, ACOE, 1989.



Feature 3. Unit 4 was also a 300-m^2, "L"-shaped collection area located at the eastern edge of the site area.

Approximately 95 lithic artifacts were collected from the site surface. These included one dart point, one side-notched arrow point, and one gun flint manufactured from Pedernal chert.

Collection Unit 1 contained no surface artifacts. The structure consisted of a semicircular arrangement of sandstone slabs which was open to the west. The structure had a 45-cm maximum height and a 1.5 x 1.5 m interior dimension.

Twenty-three lithic artifacts were located around Feature 2; the majority of these was found to the south and downslope of the feature.

Approximately 46 lithic artifacts were collected from the surface collection Unit 3.

Collection Unit 4 yielded 23 artifacts, which included two projectile points and a gunflint.

6.5.5 Subsurface Samples and Stratigraphy

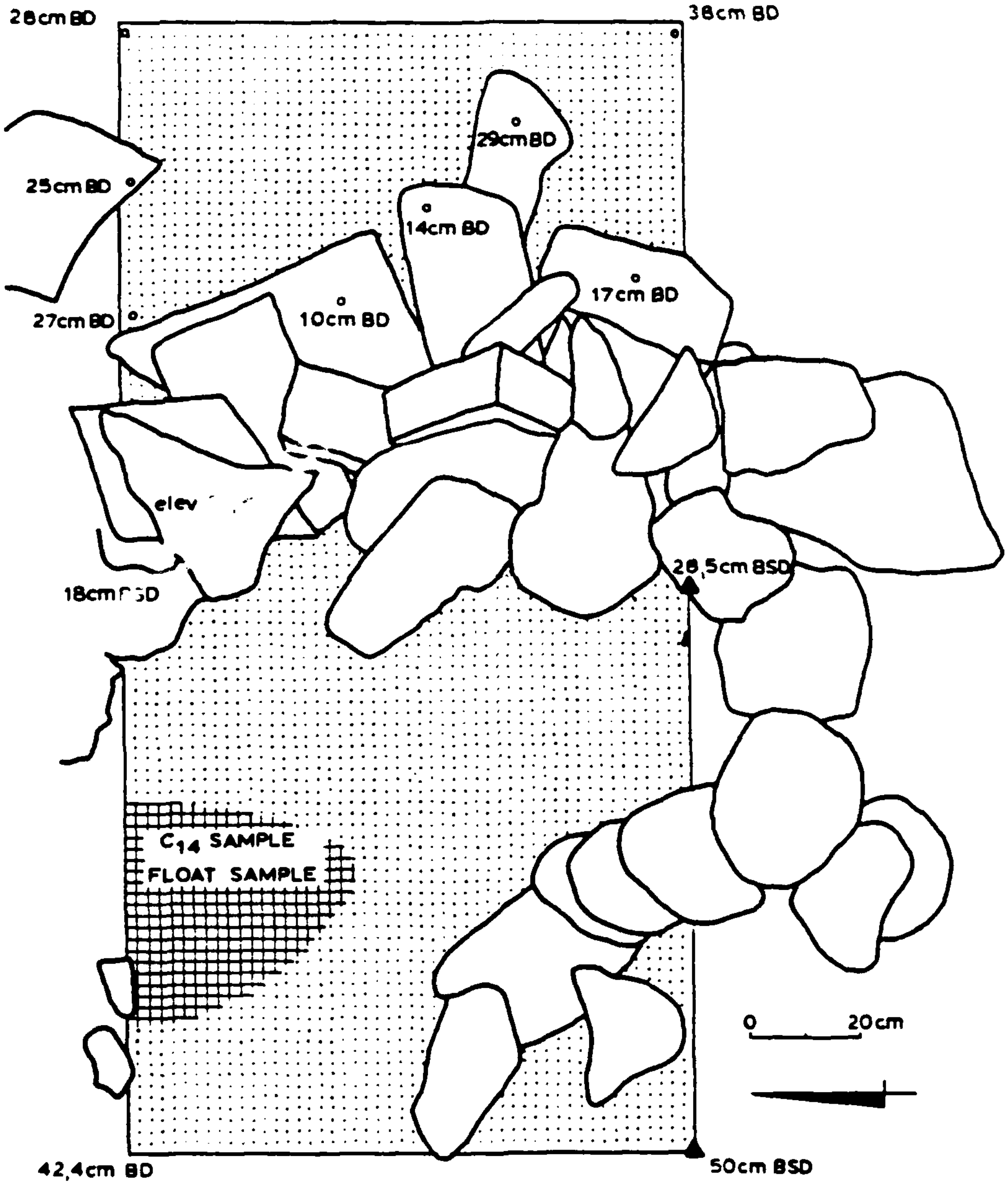
Five test pits were excavated to determine the integrity of the surface features and the depth of cultural deposits. All materials were screened through 1/4-inch mesh. Samples are described in Table 6.16. Grids 98N/69E and 98N/70E were located in and around the structure (Feature 1) (Figure 6.21). Grid 98N/69E was bounded to the east by the wall alignment; it lay inside the structure. This grid exhibited surface ash. Excavations were conducted to a 15-cm depth (Figure 6.22).

Grid 98N/70E included the wall alignment and the area outside and immediately east of the structure. Surface ash was also present in this grid, which was excavated to a 10-cm depth (Figure 6.23).

Excavation of a 1 x 2 m unit in and around Feature 1 did not locate any additional features or cultural levels. Although ash/charcoal was present in both excavation units, it was confined to the upper 10-cm level and exhibited no definite boundaries. Charcoal for radiocarbon dating was collected from grid 98N/69E; two lithics and two badly eroded, probable Penasco micaceous sherds were present in the two excavation units.

A 1 x 1 m test pit was located at 118N/82.5E to investigate hearth Feature 2. This grid was located at the half-meter coordinate so that the entire feature would be investigated (Figure 6.24). This feature was located on the low talus slope which marked the northern site boundary and was excavated to a 25-cm depth.

Figure 6.21 LA 51698, Structure 1, Level 1, Plan View, Abiquiu Archaeological Study, ACOE, 1989.



Light Ash/
Charcoal Concentration

Figure 6.22 LA 51698, N98/E69, West Profile, Abiquiu Archaeological Study, ACOE, 1989.

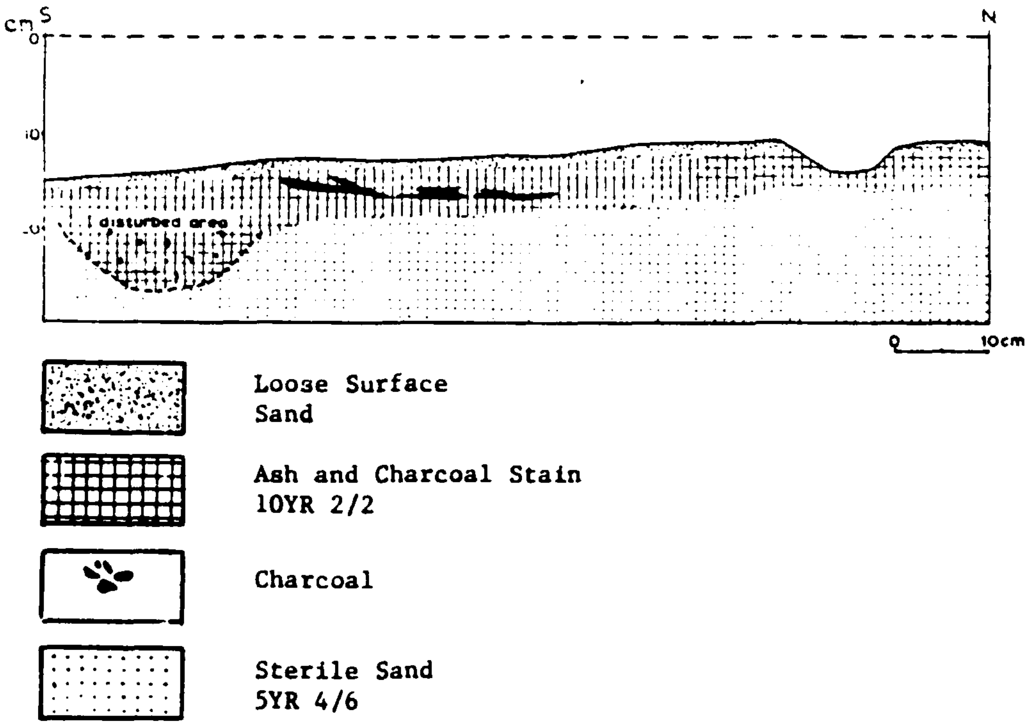


Figure 6.23 LA 51698, East of Structure 1, N98/E70, Test Pit East Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

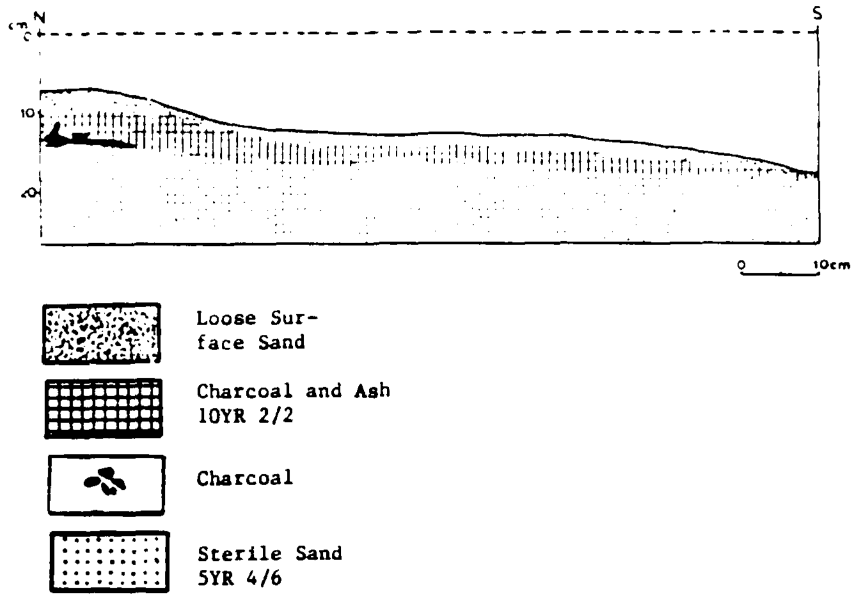


Figure 6.24 LA 51698, Feature 2 Hearth, N118/E82-83, Level 1, Abiquiu Archaeological Study, ACOE, 1989.

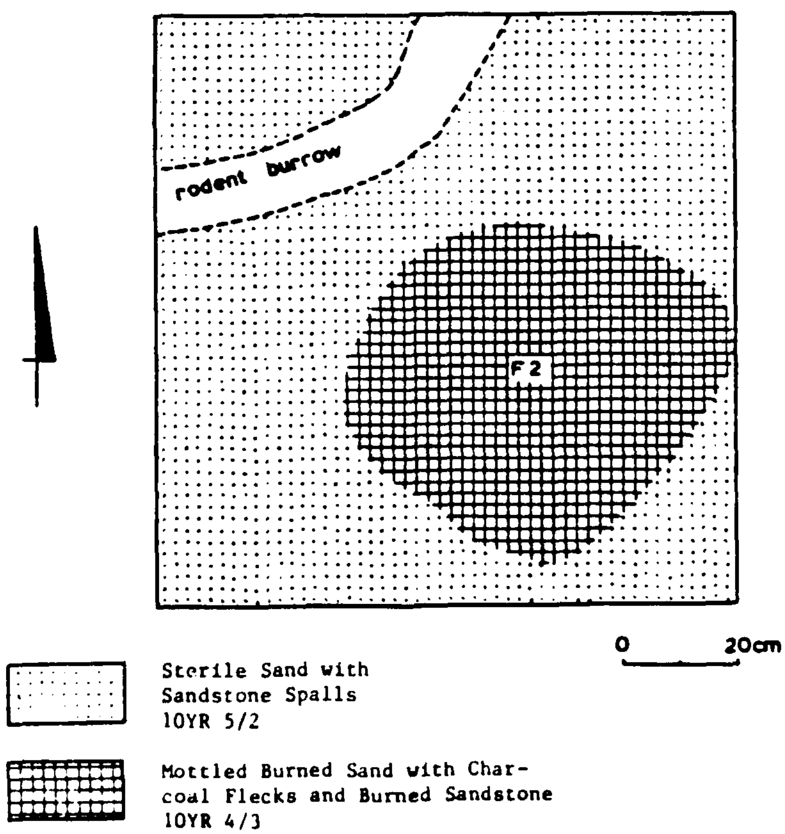


Table 6.16 LA 51698 Samples, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
N96/E96, Level 3	1	1	--
N96/E96, Level 4	--	2	--
N98/E69-70, Feature 1			
Structure 1, Level 1	4[1]	2	3[2]
Structure 1, Level 2	2	1	--
N104/E90			
Feature 2, Level 2	1	--	1
Feature 3, Level 3	1[1]	--	1[2]
N118/E82-83			
Feature 2, Level 1	2	1	2[2]
Feature 2, Level 3	2[1]	1[3]	1[2]

1 See Appendix C for results.

2 See Table 6.18.

3 See Appendix D for results.

Test unit 118N/82.5E was located over a small area of surface ash; excavation confirmed the presence of a hearth feature (Feature 2). This hearth was located immediately below the modern ground surface in a sand matrix and consisted of a round, 48-cm diameter, basin-shaped hearth. Several upright, burned, sandstone slabs were present along the northern edge of the hearth, and a few fire-cracked quartzite cobbles were present around the feature (Figure 6.25). The fill of the hearth consisted of mottled orange and black sandy ash; the bottom of the feature was defined by orange/red oxidized sand. A sufficient amount of charcoal for radiocarbon dating was collected from the hearth feature. Ten lithic and three historic ceramic artifacts were present in the excavation unit.

Grid 104N/90E was located to investigate Feature 3, which consisted of several sandstone slabs and ash exposed along a shallow arroyo. The excavation unit was located adjacent to and slightly upslope of the ash; it was excavated to a 30-cm depth (Figure 6.26). Excavation into the ash area uncovered thin, laminar sand lenses and small pockets of clay interspersed with the ash. This suggested that the feature had undergone colluvial erosion; no oxidation or reddening, indicative of in situ burning, was present. Several lithic artifacts were present in the subsurface deposits, and the majority of these was located in the second 10-cm level. A sufficient charcoal sample for radiocarbon dating was also removed from Level 2.

Grid 96N/96E was located on an area of stable sand deposits containing few surface artifacts and no features. The apparently deep sand deposits, however, suggested that buried materials could be present. This unit was

Figure 6.25 LA 51698, Feature 2, N118/E82-83, Base of Level 2, South Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

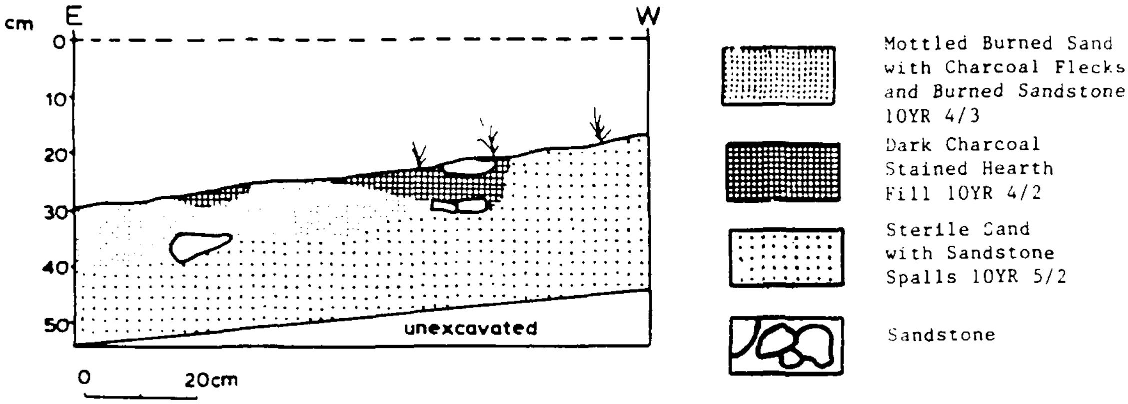
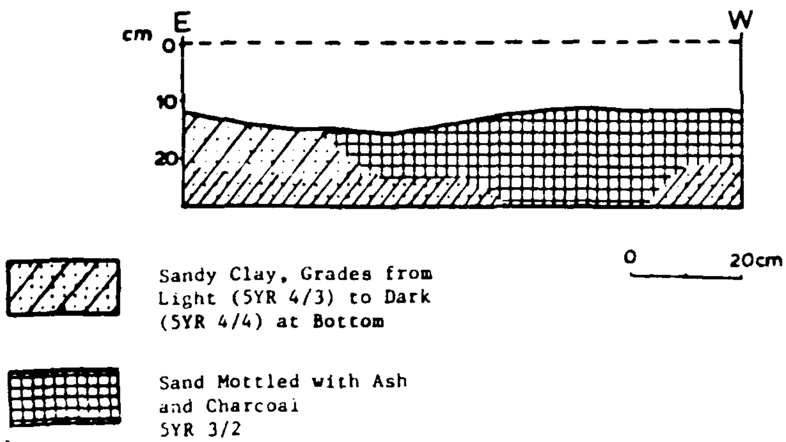
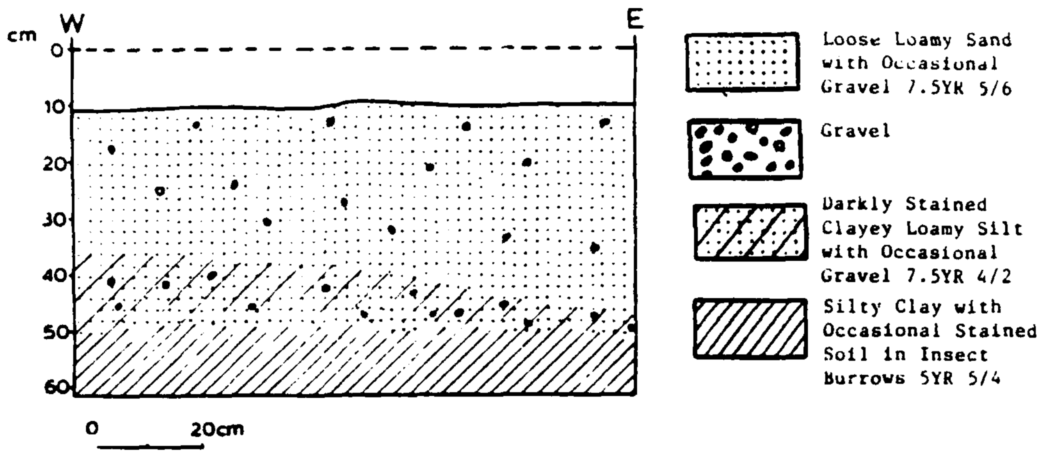


Figure 6.26 LA 51698, N104/E90, Feature 3, Base of Level 3, South Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



excavated to a 50 cm depth (Figure 6.27). The unit encountered a 4- to 12-cm thick lens of ash intermixed with sand. This lens was located 22 to 37 cm below the present ground surface and contained only small flecks of charcoal. No oxidation was present to suggest in situ burning. Nine lithic artifacts were located in the excavation unit; the majority was located in the upper 30 cm.

Figure 6.27 LA 51698, N96/E96, North Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



6.5.6 Lithic Analysis

LA 51698 represents a multicomponent lithic scatter that was collected in four surface units. Unit 1 was 10 x 10 m and was placed over the structure (Feature 1). No surface artifacts were recovered from this unit. Artifactual remains were grouped into three surface proveniences and four subsurface proveniences. Unit 2 (Provenience 1) represents a 10 x 10 m area located on the talus slope associated with hearth Feature 2. Unit 3 (Provenience 2) was a 300-m^2, "L"-shaped collection area associated with Feature 3, and Unit 4 (Provenience 3) was a 300-m^2, "L"-shaped unit located in the eastern portion of the site.

Four subsurface proveniences were created. Provenience 4 represents a test in Feature 2 (118N/82.5E), Provenience 5 a test in Feature 3 (104N/90E), Provenience 6 a test southeast of Feature 3 (96N/96E), and Provenience 7 a test in Feature 1 (98N/69-70E).

Proveniences will be discussed by unit. Surface assemblage descriptions in each unit are followed by a discussion of subsurface deposits.

The entire chipped stone assemblage recovered from LA 51698 underwent a detailed analysis. No portion of the assemblage was rough sorted.

Table 6.17 describes the chipped stone artifacts that were recovered from LA 51698. One hundred and twenty-one chipped stone artifacts and five ground stone artifacts were recovered from the site. Chipped stone artifacts included 114 flakes, six pieces of small angular debris, four projectile points, two bifaces, two unifaces, two gravers, and one core. The assemblage was comprised of locally available materials. The majority of these artifacts was manufactured from Pedernal chert (73 artifacts, 57 percent). This material was followed in frequency by Polvadera obsidian (27 artifacts, 21 percent) and Jemez obsidian (21 artifacts, 16 percent). Other low frequency materials included quartzitic sandstone (five artifacts, four percent), quartzite (two artifacts, two percent), and fossiliferous tan chert (one artifact, one percent).

Table 6.17 LA 51698 Artifact Type to Material Type Frequencies for Entire Site (Column Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type							
Material Type	Biface	Cores	Flakes	Graver	Projectile Point	Small Angular Debris	Uniface	Total
Fossiliferous Tan Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	1(1)
Jemez Obsidian	--(--)	--(--)	20(95)	--(--)	2(9)	--(--)	1(5)	23(18)
Pedernal Chert	1(1)	1(1)	65(89)	1(1)	1(1)	3(4)	1(1)	73(57)
Polvadera Obsidian	1(4)	--(--)	25(93)	--(--)	1(4)	--(--)	--(--)	27(21)
Quartzitic Sandstone	--(--)	--(--)	3(60)	--(--)	--(--)	2(40)	--(--)	5(4)
Quartzite	--(--)	--(--)	1(50)	--(--)	--(--)	1(50)	--(--)	2(2)
Total	2(2)	1(1)	114(88)	2(2)	4(3)	6(5)	2(2)	131(100)

Bidirectionally (19) and unidirectionally (one) retouched platforms indicate that formal tool manufacture was carried out among all materials with the exception of quartzite. Retouched platforms also exhibited evidence of platform preparation. Primary decortication is indicated for Pedernal chert and to some degree for Polvadera obsidian, but it is not evident for Jemez obsidian and quartzitic sandstone. Secondary interior flakes were identified in all material assemblages.

Pedernal chert was the only material class that exhibited evidence of heat treatment. Sixty percent of Pedernal materials were heat treated (44 artifacts). When successful and unsuccessful heat treatment is examined, 73 percent of the Pedernal cherts exhibited successful heat treatment (32 of 44 artifacts). Only 12 artifacts exhibited unsuccessful treatment.

Although all formal tools that were recovered from the site exhibited evidence of successful heat treatment, debitage from bifacial tool manufacture indicates that bifacial manufacture occurred on both nonheat treated materials

and heat treated materials. Forty-four percent of the biface flakes recovered from the site lacked evidence of heat treatment. The percentage of heat treatment on biface flakes was similar to that identified for core flakes. This relatively low percentage of heat treatment is not typical for most sites in the study area.

6.5.6.1 Unit 1

General Description. Unit 1 consists of a surface ceramic scatter around a Piedra Lumbre structure (Feature 1). A 10 x 10 m grid was placed over and around the structure. No surface artifacts were encountered.

Provenience 7. Provenience 7 is a 1 x 2 m subsurface test pit (98N/69-70E) that was placed in and adjacent to the structure (Feature 1). Lithic artifacts recovered from this area include two flakes. These flakes were manufactured from Pedernal chert. Both exhibited less than 25 percent cortex and single-facet platforms. The low frequency of chipped stone debris prohibits interpretations of reduction and tool manufacture. One Penasco micaceous sherd was noted.

6.5.6.2 Unit 2

Provenience 1. Unit 2 represents a 10 x 10 m collection unit that was placed over a hearth (Feature 2). Five lithic artifacts were recovered from this area. They included four flakes and one piece of small angular debris. Three artifacts were manufactured from Pedernal chert and two from quartzite. All materials are locally available. A further discussion of reduction and manufacture is limited by the low frequency of debitage in this area. No formal tools or ground stone artifacts were recovered.

Provenience 4. Provenience 4 is the test pit associated with Feature 2. Artifacts recovered included six flakes. All were manufactured from Pedernal chert. Although counts are low, two flakes exhibited bidirectionally retouched platforms indicating formal tool manufacture. No other lithic artifacts were recovered from this area. Four sherds of the Penasco Micaceous type were recovered.

6.5.6.3 Unit 3

Provenience 2. Unit 3 is a hearth (Feature 3) and an associated 10 x 10 m lithic scatter. Sixty-five chipped stone artifacts and four ground stone artifacts were recovered from this area. Chipped stone included 58 flakes and pieces of small angular debris, one biface, two unifaces, two gravers, one projectile point, and one core.

The majority of these artifacts was manufactured from Pedernal chert (63 percent, 41 artifacts). This material was followed in frequency by Polvadera obsidian (23 percent, 15 artifacts). The remaining 14 percent represented three local material categories.

Two formal chipped stone tools recovered from this area of the site indicate that tool manufacture as well as tool use occurred. An early biface

and a uniface represent manufacturing failures. The biface was manufactured from unsuccessfully heat treated Pedernal chert and indicates that early bifaces may have been heat treated. One of the gravers, on the other hand, exhibited completed morphology.

Four artifacts exhibited marginal retouch suggesting additional functional variability. Cutting activities were indicated by two bidirectionally retouched artifacts and scraping activities by two unidirectionally retouched artifacts. No expedient flake tools were recovered.

The ground stone that was recovered from this area appears to represent a variety of grinding activities. Four ground stone fragments represented three grinding implements. These implements included a flat slab metate and two grinding slabs, one of fine sandstone and the other of medium-grained sandstone (two fragments).

The lithic artifacts recovered from this area represent considerable functional diversity. Debitage indicates formal tool manufacture as well as formal tool use. Marginally retouched artifacts indicate that scraping and cutting activities probably occurred.

Provenience 5. Provenience 5 is a subsurface test pit that was placed in Feature 3. Eighteen flakes were recovered from this test pit; 16 were manufactured from Jemez obsidian and two from Polvadera obsidian. A Jemez obsidian preform was present on the surface. The overall assemblage indicates that secondary reduction and tertiary formal tool manufacture occurred. Formal tool manufacture was indicated by five bidirectionally retouched platforms. Three of these exhibited evidence of platform preparation. Little evidence of primary decortication was present.

The subsurface materials that were recovered from this test pit were not similar to materials recovered from the surface in this area. The high percentage of Jemez obsidian indicates that a discrete formal tool manufacturing area, not related to the surface components, may exist.

Provenience 6. Provenience 6 represents a test pit placed in a low density area to determine if subsurface, intact deposits existed. Chipped stone artifacts included eight flakes and one piece of small angular debris. Six artifacts were manufactured from Pedernal chert, two from Polvadera obsidian, and one from quartzitic sandstone. Although counts are low, three Pedernal flakes exhibited bidirectionally retouched platforms that suggest bifacial tool manufacture occurred. The materials recovered from this test are similar to those recovered from the surface in this area.

6.5.6.4 Unit 4, Provenience 3

Unit 4 is a 300-m^2 collection unit in the eastern portion of the site. Twenty-four chipped stone artifacts and one ground stone fragment were recovered from this area. Chipped stone artifacts included 21 flakes, one piece of small angular debris, a projectile point, and a biface. The majority of materials was manufactured from Pedernal chert (15 artifacts, 63 percent).

Two formal tools, a projectile point, and a gun flint were recovered from Provenience 3 (see Appendix F). The projectile point was a palmate dart point exhibiting complete morphology. It was manufactured from Polvadera obsidian. The gunflint was manufactured from successfully heat treated Pedernal chert. It measured 17 mm long by 17 mm wide by 3 mm thick (Figure 5.4B). Compared to standard gun flint sizes specified in U.S. Army manuals and in a collection purchased from U.S. Army stores (Appendix E.4), the item from LA 51698 best fits the pistol category. The short length, which does not fit any of the government categories, may be due to resharpening. Estimated age of this gun flint from a remote area such as Abiquiu is A.D. 1650 to 1870-1880 (Earls et al 1989:201). Although its overall morphology was typical of a gun flint, it lacked evidence of compared use. The reasons for its discard are unknown.

No marginally retouched tools or expedient flake tools were recovered from this area of the site.

6.5.6.5 Unit 9

Two projectile points were recovered outside the collection units. These were a triangular, unnotched point of Jemez obsidian (Figure 8.1H). A Pedernal chert dart/arrow point was side-notched and may have been discarded due to manufacturing failure.

6.5.6.6 Summary

The lithic artifacts that were recovered from the site indicate a variety of activity areas. In general, formal tool manufacture is represented, and in some areas formal tool use is indicated but to a limited degree. Provenience 2 appears to represent the primary use activity area. Other areas appear to be restricted to tool manufacture. Although no lithic debris was found in association with the structure, the percentage of heat treatment on bifacial debitage found on the site is similar to sites with later occupation components. The routine use of heat treatment as a formal tool manufacturing strategy may not be constant through time. Future studies must examine heat treatment through time as well as variability in heat treatment strategies within a given time period.

6.5.7 Chronology

Thirty-one lithics and sherds of one ceramic vessel were present in the subsurface materials. The three pieces of possible Penasco Micaceous (Dick 1968) or Ocate-like (Gunnerson 1969) ware were located in the Feature 1 structure. Because of the similarity of these micaceous wares, it is difficult to determine if the sherds represent Ocate, perhaps produced by Apaches, or the Penasco variety produced by Hispanics (see Warren 1981). The Penasco ware is frequently associated with Hispanic pastoral activity sites (see Chapter 11). C-14 dates are given in Table 6.18. Further details on chronology are presented in Chapters 7 and 8.

Table 6.18 LA 51698 C-14 Dates, Abiquiu Archaeological Study, ACOE, 1989[1].

UT No.	Provenience	Uncorrected Date
5510	N104/E90, Feature 3, Level 3, Sample 24	1560 B.C. ± 120
5509	N98/E70, Structure 1, Level 1, Samples 15-16	A.D. 800 ± 50
5511	N98/E69, Structure 1, Level 1, Sample 8	A.D. 1880 ± 60
5512	N98/E70, Structure 1, Level 1, Samples 13-14	A.D. 1740 ± 70
5508	N118/E82-83, Feature 2/2A, Level 1, Samples 3&5	A.D. 1330 ± 70
5514	N118/E82-83, Feature 2, Levels 2-3, Sample 20	A.D. 1060 ± 60

1 All dates are from the University of Texas - Austin Radiocarbon Laboratory.

6.5.8 Summary

Approximately 125 artifacts were collected from an 800-m^2 surface collection and five excavation units. These included artifacts temporally diagnostic of late Archaic and early Historic occupations. Three radiocarbon samples were collected from the three features.

6.5.9 Recommendations

The extent of the site or boundaries of an adjacent unrecorded site should be determined by mapping and collection.

6.6 LA 25480

6.6.1 Physiographic Setting

This extremely large site is located on the eastern flanks of the Rio Chama at elevations from 6275 to 6335 feet. The old river channel lies approximately 1,600 m southwest of the site area. This area is characterized as a very broad mesa which slopes gradually to the southwest. The deeply entrenched north fork of Comanche Canyon lies immediately east and southeast of the site area, and the site parallels the northwestern escarpment of this canyon. The surface of the site area is characterized by stable, grass-covered loams with sandstone bedrock exposed along the canyon and in occasional small patches to the north of the canyon.

6.6.2 Previous Work

The original survey (Schaafsma 1976:58) described this as a large lithic scatter with an occasional sherd or historic artifact, occupying a 17,500-m^2 area. The site was revisited by Nickens' crews, but no description was given (Reed et al. 1982:18,128).

6.6.3 Field Methods

Owing to its large size, only a small portion of the site area was examined during the present project. This area was located approximately 150 m from the southern site boundary and appeared to be one of the more artifactually dense locations. In this area the landform slopes to the south; artifacts were located along and within 80 m of the western rim of the canyon. No surface features were discernible in this area.

A new datum was established and nominated as 400N/300E. A collection strategy was implemented to sample a 1,200-m^2 area of the site. It involved a four-part zigzag transect designed to crosscut the gradual southern trending slope while sampling the materials immediately adjacent to and at some distance from the canyon edge. Each transect part consisted of a 10 x 30 m collection unit (Figure 6.28). Collection Unit 1 was oriented north-south and was located adjacent and parallel to the canyon edge. Patches of sandstone bedrock are exposed throughout the unit, and sand deposits appeared to be shallow and unstable.

6.6.4 Collection Units

Collection Unit 1 contained approximately 1,000 lithic artifacts including five complete or fragmentary projectile points. The surface density in this unit exhibited a uniform distribution of lithic artifacts with a maximum density of 21 items/m^2. A 7-m^2 area in the northwest corner of this collection unit contained 14 Penasco Micaceous sherds.

Collection Unit 2 abutted the southwestern corner of Unit 1 and had an east-west orientation which ran perpendicular to the canyon and Unit 1. This unit was situated on stable sandy loams with exposed patches of bedrock.

Unit 2 contained approximately 1,000 artifacts and included one En Medio and one San Jose to En Medio style point. A lithic concentration was present at the southern end of the collection area where the artifacts reached a surface density of 29 items/m^2.

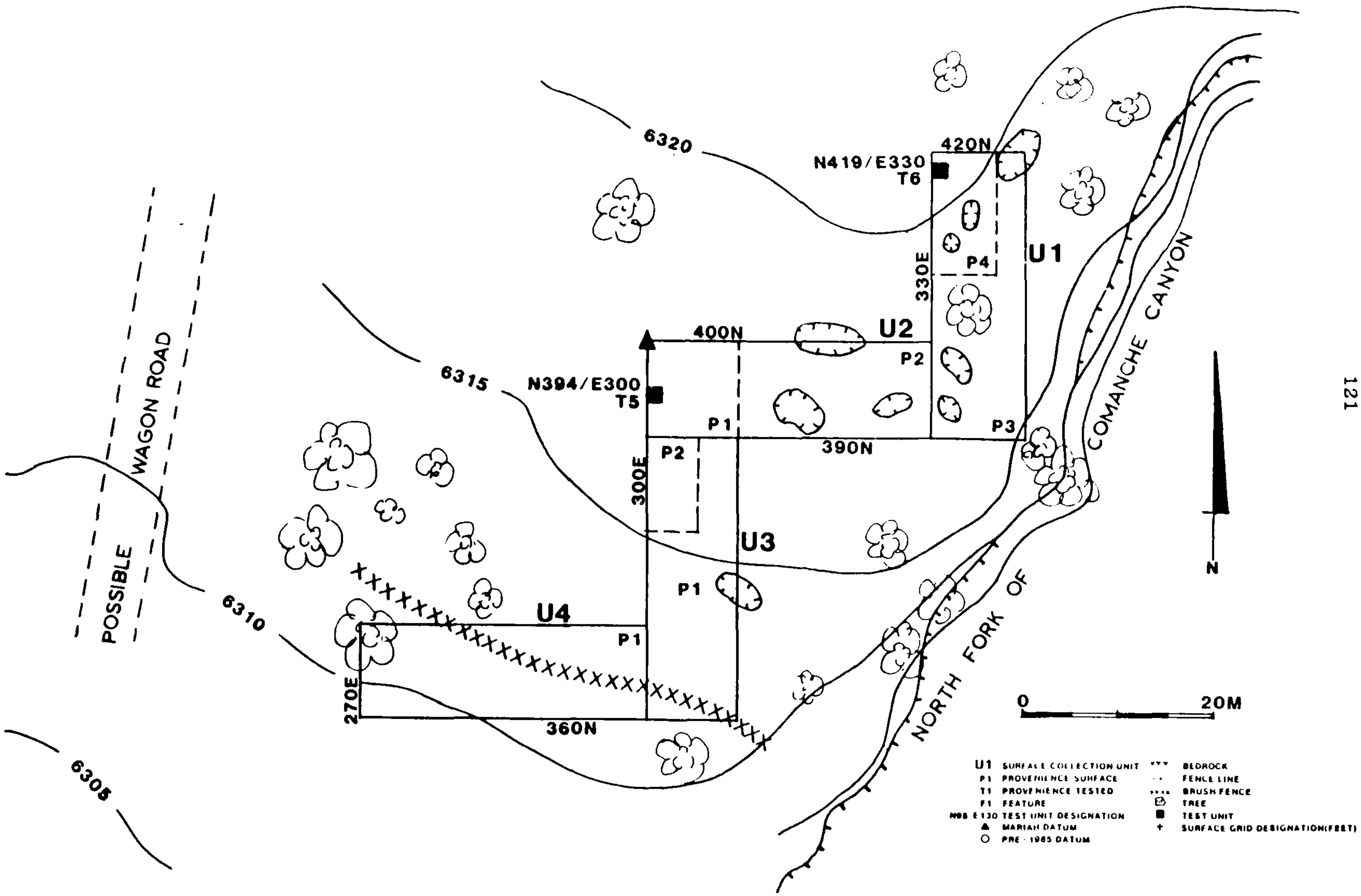
Collection Unit 3 was located off the southwestern corner of Unit 2 and had a north-south orientation which ran parallel to the slope. This unit was located on stable loams with only two small areas of exposed bedrock.

The edge of the lithic concentration in Unit 2 was also present at the northern end of Unit 3, which contained 700 artifacts. The surface density for the unit was highest in this area, where a maximum of 19 items/m^2 was present. Three complete and fragmentary projectile points and one Penasco Micaceous sherd were also present in this unit.

Collection Unit 4 was located entirely on stable loam deposits. This unit was the southernmost sample and farthest from the canyon edge. It was oriented east-west and abutted the southwest edge of Unit 3.

Collection Unit 4 exhibited the lowest surface density of the sample area. Approximately 200 artifacts were present in this area; the maximum

Figure 6.28 LA 25480, Abiquiu Archaeological Study, ACOE, 1989.



density was 12 items/m^2. Included in the artifacts were one blue glass bead and one San Jose En Medio point. A low brush fence which runs perpendicular to the canyon was located along the northern edge of this unit.

6.6.5 Subsurface Samples and Stratigraphy

Two test pits were excavated within the surface collection area. Samples are given in Table 6.19. Grid 419N/330E was located in the northwest corner of area 1. This unit was located to investigate a small scatter of ceramics and determine the depth of sand deposits. This unit was excavated to a maximum depth of 26 cm.

Table 6.19 LA 25480 Samples, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
N394/E300, Levels 1-2	1	1	--
N419/E330, Level 2	2	1	--

One hundred and sixty lithics and one ceramic artifact were recovered using 1/8-inch screen. The majority of these was located in the second 10-cm level. The matrix within the unit consisted of a sandy loam with small tabular fragments of sandstone (Figure 6.29). The size of sandstone clasts increased with the depth of the unit, and bedrock was reached 12 to 26 cm below the modern ground surface.

Grid 394N/300E was located in the western end of collection Unit 2. This test pit was situated in an apparent surface lithic concentration and excavated to a depth of 14 cm. All materials were screened through 1/4-inch mesh. One hundred and forty lithic artifacts were present in this test pit. The subsurface matrix consisted of a sandy loam containing small, friable, sandstone spalls; bedrock was encountered 10 to 14 cm below the modern ground surface (Figure 6.30).

6.6.6 Rough Sort and Detailed Lithic Analysis

LA 25480 represents a large lithic scatter varying in density. Due to the size of LA 25480, a sampling strategy was implemented to surface collect 1,200 m^2 of the site. A four-part zigzag transect was placed to crosscut a gradual slope toward the south. All units were placed adjacent to one another.

Surface distribution maps were examined to identify horizontal proveniences. These maps indicated that proveniences crosscut the field unit collections and resulted in four surface proveniences (Proveniences 1-4) and two subsurface proveniences (Proveniences 5 and 6). The proveniences are described below.

Figure 6.29 LA 25480, N419/E330, North Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

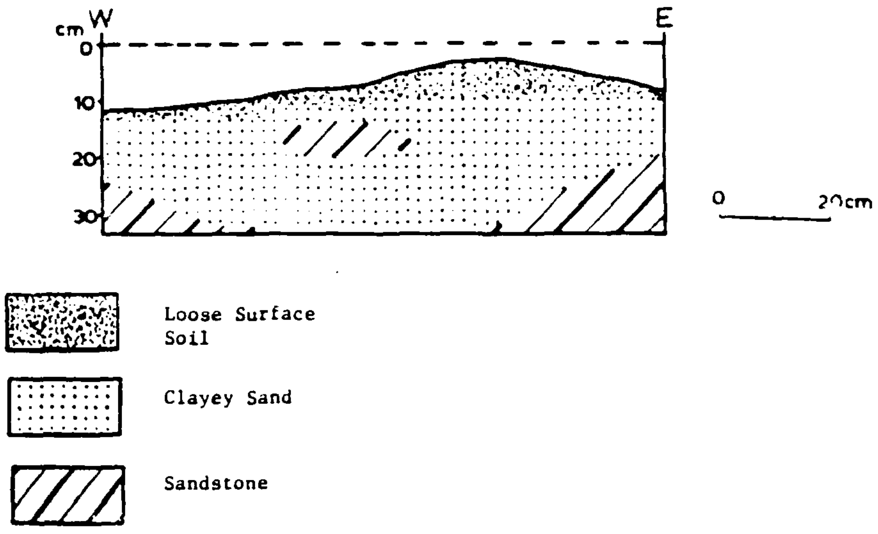
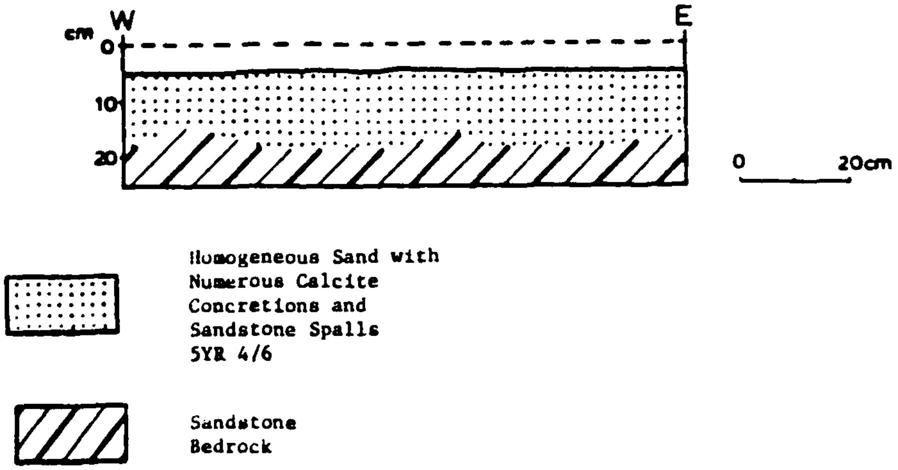


Figure 6.30 LA 25480, N394/E300, North Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



Provenience 1 represents a generalized low density scatter west of 310E. This provenience includes all of Units 3 and 4 and the western portion of Unit 2. Provenience 2 is a high density scatter located between grid units 380-400N/300-306E. It includes the northwest corner of Unit 3 and the western end of Unit 2. Provenience 3 represents a generalized low density scatter east of 310E. It includes the eastern portion of Unit 2 and the portion of Unit 1 outside of Provenience 4. Provenience 4 represents a high density scatter located within Provenience 3. It was located in 407-419N/330-336E, the northwest corner of Unit 1.

The subsurface proveniences included test pit 394N/300E (Provenience 5), a test in Provenience 2, and test pit 419N/330E (Provenience 6), a test pit in Provenience 4. Artifacts that were recovered from outside of collection units were designated as Provenience 9.

A total of 3,523 stone artifacts was recovered from LA 25480 (Table 6.20). These artifacts included 3,474 flakes and pieces of small angular debris, 22 bifaces, five unifaces, 15 projectile points, one drill, and five pieces of ground stone.

Table 6.20 LA 25480 Artifact Type to Material Type Frequencies (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type								
Material Type	Biface	Cores	Drill	Flakes	Miscellaneous	Projectile Point	Small Angular Debris	Uniface	Total
Unknown	1(50)	--(--)	--(--)	1(50)	--(--)	--(--)	--(--)	--(--)	2
Brown Jasper	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1
Fossiliferous Tan Chert	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	1
Jemez Obsidian	--(--)	--(--)	--(--)	594(99)	--(--)	1(<1)	5(<1)	1(<1)	601
Miscellaneous Chert	--(--)	--(--)	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	1
Morrison Green Chert	--(--)	--(--)	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	1
Moss Jasper	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	1
Nacimiento Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1
Pedernal Chert	11(<1)	3(<1)	1(<1)	1,381(95)	1(<1)	2(<1)	58(4)	2(<1)	1,459
Polvadera Obsidian	7(<1)	2(<1)	--(--)	1,389(96)	--(--)	8(<1)	35(2)	2(<1)	1,443
Quartzitic Sandstone	1(12)	--(--)	--(--)	4(50)	--(--)	1(12)	2(25)	--(--)	8
Quartzite	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1
Silicified Wood	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1
Vitrophyre	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1
Obsidian Ridge Obsidian	--(--)	--(--)	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	1
Total	22(<1)	5(<1)	1(<1)	3,374(96)	1(<1)	15(<1)	100(3)	5(<1)	3,523

A detailed analysis was conducted on a sample from each collection unit. The sample was chosen on the basis of field distribution maps and included 446 artifacts. The rough sort data are reported for the proveniences described above. Information gained from the detailed analysis is included when applicable.

Pedernal chert was the only material that exhibited heat treatment. Eighty-eight percent of this assemblage was heat treated (1,296 artifacts). Only 10 percent lacked heat treatment (185 artifacts). A large percentage of the heat treated materials was successfully treated (92 percent; 1,186 artifacts).

When artifact type and heat treatment are examined, the assemblage exhibits percentages of heat treatment that are similar to most sites in the study area. In general assemblages exhibit between 80 percent and 100 percent heat treatment among categories of formal tool debitage. In this case 94 percent of biface flakes and 96 percent of uniface flakes exhibited heat treatment. Between 97 percent and 100 percent of these were successfully heat treated. Two bifaces and one uniface lacked evidence of heat treatment. An examination of the stage of tool manufacture may provide insight to strategies of heat treatment.

In addition to formal tools and biface flakes, core flakes on this site exhibited abnormally high percentages of heat treatment. While 87 percent of the core flakes in this assemblage were treated, most sites exhibited approximately 60 percent heat treatment among core flakes. These data suggest that heat treatment was used both for formal tool manufacture and for core reduction (Table 6.21).

6.6.6.1 Provenience 1

Provenience 1 is the western portion of the generalized low density scatter. A total of 693 chipped stone artifacts and one piece of ground stone was recovered from Provenience 1. Chipped stone included 676 flakes and pieces of small angular debris, 11 bifaces, four projectile points, and two cores. The majority of the assemblage was comprised of Pedernal chert (54 percent, 372 artifacts), Polvadera obsidian (27 percent, 188 artifacts), and Jemez obsidian (18 percent, 127 artifacts). The remaining one percent consisted of six artifacts which represented six material classes. One flake was manufactured from vitrophyre basalt which outcrops in the San Antonio Mountains.

The assemblages of Pedernal chert, Polvadera obsidian, and Jemez obsidian represent formal tool manufacturing. Between 94 percent and 99 percent of these assemblages lacked cortex. Among Pedernal and Polvadera assemblages, retouched platforms made up 35 percent and 34 percent, respectively, of the flakes with platforms. Among Jemez obsidian retouched platforms comprised 80 percent of flakes with platforms. This represents the greatest evidence of formal tool manufacturing identified on sites in the study area.

Table 6.21 LA 25480 Heat Treatment of Chert to Artifact Type Frequencies for Entire Site Abiquiu Archaeological Study, ACOE, 1989.

	None	Total / Treated	Successful	Unsuccessful	Successful Core	Successful Flake	Total / Successful	Total
Biface Flake	10	150	129	5	16	--	145	160
Biface	2	9	5	4	--	--	5	11
Multiplatform Core	--	2	2	--	--	--	2	2
Tested Core	1	--	--	--	--	--	--	1
Core Flake	35	234	194	36	4	--	198	26[illegible]
Drill	--	1	1	--	--	--	1	1
Heat Spall	--	1	--	1	--	--	--	1
Pressure Flake	--	6	2	--	4	--	6	6
Projectile Point	--	3	2	--	--	1	3	3
Small Angular Debris	10	48	29	18	--	1	30	58
Unidentified Flake	122	753	649	45	59	--	708	875
Unifacially Retouched Flake	4	88	86	--	2	--	88	92
Uniface	1	1	--	1	--	--	--	2
Total	185	1,296	1,099	110	85	2	1,186	1,481

Two cores were recovered from this area. Both were manufactured from Pedernal chert. A tested core lacked evidence of heat treatment, while a multiplatform core exhibited unsuccessful heat treatment.

Formal tools included one blank, seven early bifaces, two bifacial tools, four projectile points, and one unknown tool. The majority of these tools was manufactured from Pedernal chert (seven artifacts) and obsidian (four artifacts). Other materials included quartzitic sandstone (one artifact), tan chert (one artifact), and moss jasper (one artifact).

Four projectile points and two bifacial tools exhibited completed morphology. The seven early biface fragments and the blank were manufacturing failures. These data support other information indicating that formal tool manufacture and formal tool utilization occurred at this location.

Heat treatment occurred on all nonobsidian formal tools. In all but two cases heat treatment was successful. There was no evidence of bifacial manufacture on nonheat treated formal tool artifacts.

All projectile points were also completed. Two corner-notched arrow points (one Pedernal chert and one Polvadera obsidian) date between A.D. 100 and 800 (see Chapter 8). An additional Polvadera obsidian point was assigned to the Atrisco/Armijo Period, and a Pedernal chert point was described as a palmate dart.

Marginal retouch was identified on three artifacts. Retouch was unidirectional indicating scraping activities. Six of these artifacts were manufactured from Pedernal chert and three from Polvadera obsidian. No evidence of expedient flake tool use was identified.

The assemblage that was recovered from Provenience 1 clearly indicates the manufacture and use of formal tools. The Jemez obsidian assemblage represented the greatest evidence of formal tool manufacture among sites in the study area.

6.6.6.2 Provenience 2

Provenience 2 represents a high density area in the northwest corner of Unit 3 and west end of Unit 5. A total of 1,054 chipped stone and three ground stone artifacts was recovered from this area. Chipped stone included 1,047 flakes and pieces of small angular debris, three bifaces, two unifaces, one projectile point, and one drill.

This provenience exhibited only three material types -- Pedernal chert (45 percent), Jemez obsidian (34 percent), and Polvadera obsidian (21 percent). This was one of the few assemblages that exhibited high percentages of Jemez obsidian. It was also one of the few assemblages that lacked the low frequency material types generally represented.

Nine formal tools provide evidence of formal tool manufacture and use in this provenience. These tools included one blank, one early biface, one projectile point, three drills, and two unifaces. Five artifacts were manufactured from Pedernal chert and three from obsidian (two Polvadera and one Jemez). The limited number of Jemez obsidian formal tools represented in this assemblage suggests that they were manufactured successfully and taken to another location for use.

Drilling and scraping activities are indicated by three drills and two unifaces that exhibited completed morphology. Completeness on one additional drill fragment could not be determined.

Heat treatment was identified on all Pedernal tools with the exception of one uniface. All heat treated tools exhibit successful heat treatment. The nonheat treated uniface suggests that dual strategies of heat treatment exist.

Two ground stone implements were represented by three fragments. Both were manos, manufactured from quartzite and quartzitic sandstone. These artifacts provide evidence of additional functional variability.

There were no expedient flake tools or marginally retouched tools recovered from this provenience. These data indicate that this provenience represents a formal tool manufacturing and formal tool use area. Activities represented in this area include drilling, scraping, cutting, and grinding.

6.6.6.3 Provenience 3

Provenience 3 is the eastern portion of the low density lithic scatter. A total of 1,107 chipped stone artifacts and one piece of ground stone was recovered from this area. Chipped stone included 1,094 flakes and pieces of small angular debris, three bifaces, three unifaces, five projectile points, and one core. One noncultural item was included.

Again, the Polvadera obsidian assemblage was larger than the Pedernal assemblage. Polvadera obsidian made up 53 percent (584 artifacts) and Pedernal chert 38 percent (418 artifacts). Although Jemez obsidian was represented, it made up only nine percent (101 artifacts) of the entire assemblage. Four additional artifacts were made of quartzitic sandstone (three) and silicified wood (one).

The formal tool assemblage provides data that indicate the manufacture of unifacial and bifacial tools as well as the use of scraping tools. Twelve formal tools were recovered from this area and included four early bifaces, five projectile points, and three unifaces. One projectile point was recovered outside of the collection unit. Eight artifacts were manufactured from Polvadera obsidian, three from Pedernal chert, and one from quartzitic sandstone. Again, the lack of Jemez obsidian tools indicates that they were successfully manufactured for use in another area.

Four of the 12 artifacts exhibited morphology that indicated they were completed. These artifacts included two unifaces and two projectile points. One projectile point fragment could not be identified as complete or incomplete. The remaining artifacts represented manufacturing failures.

Two of the projectile points exhibited lanceolate dart morphology while another was a corner-notched arrow point dating between A.D. 100 and 800.

Two of the three Pedernal chert artifacts exhibited unsuccessful heat treatment. These included a uniface and an early preform. There was no evidence of nonheat treated formal tool manufacture.

Evidence of scraping activities was identified in four unidirectionally, marginally retouched scraping tools; two were manufactured from Pedernal chert and two from Polvadera obsidian. No expedient flake tools were recovered.

A portion of an undetermined mano indicated that grinding activities may have occurred at the site. It was manufactured from quartzite and exhibited one convex grinding surface.

The assemblage that was recovered from Provenience 3 represented bifacial and unifacial tool manufacture and tool use. Scraping and cutting activities were represented. The presence of incompleted projectile points indicated their manufacture at the site. The completed basal fragment indicated that it was removed from the haft at the site. Grinding activities were also suggested.

6.6.6.4 Provenience 4

Provenience 4 is a high density lithic concentration in the northwest corner of Unit 1. A total of 667 artifacts was recovered from Provenience 4. These included 658 flakes and pieces of small angular debris, five bifaces, two projectile points, and two cores. Polvadera obsidian made up the majority of the assemblage (68 percent, 455 artifacts). Pedernal chert was the only other high frequency material type (28 percent, 189 artifacts). Jemez obsidian represented only two percent (14 artifacts) of this concentration.

Two multiplatform exhausted cores were recovered from this provenience. They were both manufactured from Polvadera obsidian.

The formal tools that were recovered from this area provide evidence that tool manufacture occurred at the site. Six formal tools were recovered and included three early bifaces, two projectile points, and one blank. With the exception of one projectile point, all artifacts were manufacturing failures.

Marginally retouched flakes provided evidence of scraping activities at the location. Four Pedernal flakes and two Polvadera flakes exhibited unidirectional retouch. There was no evidence of expedient tool use.

The assemblage, like others, indicated the manufacture and resharpening of formal tools. Although scraping tools were represented, the presence of bidirectionally retouched platforms with remnant use indicated cutting activities also.

6.6.6.5 Provenience 5

Provenience 5 represents a subsurface test pit in the Provenience 2 lithic concentration. A single Pedernal chert biface was recovered.

6.6.6.6 Summary of Activity Areas

The lithic assemblage that was recovered from LA 25480 represents a formal tool manufacturing and utilization area. Proveniences across the site provide varied evidence of tool manufacture among Polvadera obsidian, Pedernal chert, and Jemez obsidian. The use of tools manufactured from Polvadera obsidian and Pedernal chert is clear. Both cutting and scraping tools are represented. It appears that Jemez obsidian tools were successfully manufactured and taken to another location for use. Additional functional variability is indicated by the ground stone recovered from the site.

It is unclear why this assemblage exhibited such a high percentage of nonheat treated debitage from formal tool manufacture. Although a nonheat treated uniface was identified (Provenience 2), the remaining Pedernal formal tools exhibited heat treatment. When successful and unsuccessful heat treatment were examined on formal tools, four early bifaces exhibited unsuccessful heat treatment. It is unlikely that bifacial manufacture would occur on unsuccessfully treated flakes. Therefore, these data may indicate that early bifaces were manufactured from nonheat treated materials and then heat treated to facilitate further bifacial manufacture.

6.6.7 Other Artifacts

Ceramic artifacts recovered from LA 25480 appear to be limited to 15 Penasco Micaceous sherds (Chapter 11). This type dates from A.D. 1600-1900.

Bone was recovered during surface collection at 369N/301E and excavation at 419N/330E. The 13 pieces of surface material consist of medium or small vertebral and other fragments, heavily masticated, eroded, and matted with hair. They probably represent coyote scat containing lagomorph remains. The single piece of subsurface material is a tabular large mammal fragment, roasted and burned to a gray-tan. It probably is a fragment of a small or medium artiodactyl (pig, sheep, goat, deer, pronghorn) mandible.

Five historic artifacts were found. Four of these are apparently the flattened fragments of a brass thimble found at 371N/302E. The fifth item is a blue, glass, flat-ended bead, found at 362N/289E on an anthill. Round beads, like this item, of cobalt blue coloring, have been manufactured since A.D. 1780. Carrillo (personal communication 1986) judged the item to be on the order of 100 years old, based on patina and color.

6.6.8 Chronology

Artifacts included five diagnostic projectile points, all probably Late Archaic in style. Fifteen sherds, probably Penasco Micaceous dating to A.D. 1600 to 1900, were also present. The majority of these was located in one small concentration in collection Unit 1. Additional early historic artifacts included three pieces of brass and one glass bead. Chapter 7 provides more information on site occupational history, based on obsidian hydration results.

6.6.9 Summary

Approximately 3,300 artifacts were present in a 1,200-m^2 surface collection and two excavation units. These included artifacts dating from the mid-Archaic to the Historic Period. Minimal subsurface testing indicated dense subsurface cultural materials are present in shallow deposits.

6.6.10 Recommendations

Site boundaries to the west and north should be determined by mapping and collection. The historical road should be mapped.

6.7 LA 27018

6.7.1 Physiographic Setting

This large, multicomponent, lithic site is approximately 2,200 m east of the Rio Chama at an elevation ranging from 6305 to 6315 feet. The site is situated along a large, east-west trending mesa which lies immediately south of Comanche Canyon. The western and northwestern edges of the mesa are defined by a sandstone escarpment which varies from a gentle to a precipitous slope. Below and to the southwest of this escarpment is a broad, relatively

flat bench. Artifacts along the upper portion of the mesa are exposed on the sandstone slickrock, and to the east along the juncture of bedrock and stabilized sand deposits. Artifacts are also present on the bench below and to the west of the sandstone bluffs. Deposits on the bench consist of stable colluvial sands and loams.

6.7.2 Previous Work

The original survey (Schaafsma 1976:58) reports LA 27018 as a 1,450 x 40 m lithic site with an estimated 10,000-500,000 artifacts. The presence of some fire-cracked rock was also noted. The site was cursorily revisited and staked in 1982 (Reed et al. 1982:118). Examination of the site area during the present study confirmed the immense size of this scatter. Large concentrations of artifacts were noted on and near the sandy deposits which cap the mesa top, on the slickrock and shallow sand deposits near the edge of the escarpment, and in sandy deposits on the bench below the sandstone escarpment. Evidence of historic usage of the site area was also apparent; a large brush corral was noted at the base of the escarpment, associated with recent hearths. A very old road or trail cuts east-west across the site; this appears to be the same road reported to the northwest on sites LA 47940 and LA 47941 (Lord and Cella 1986).

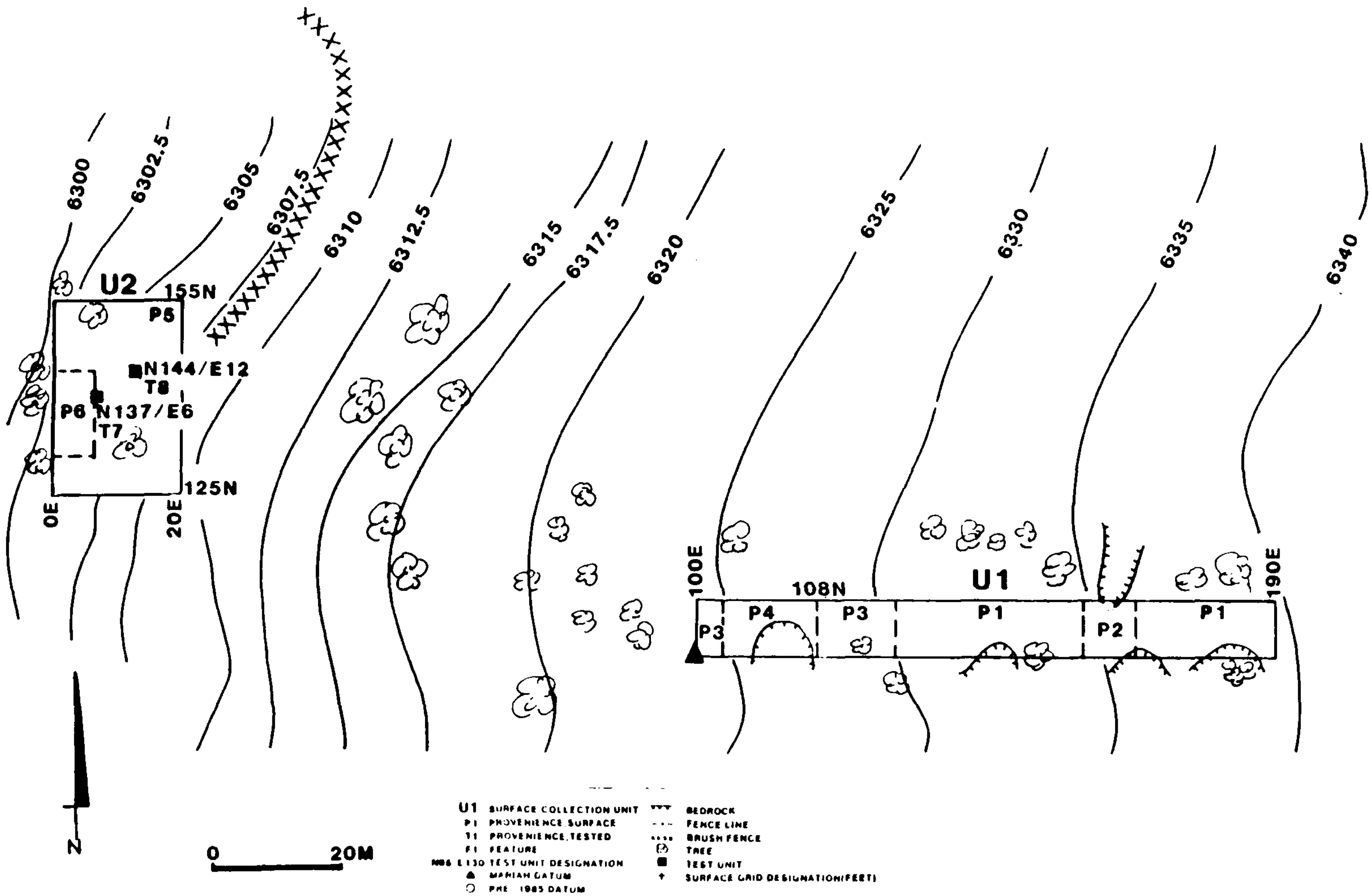
6.7.3 Field Methods

Owing to the immense site size and the contextual diversity of artifactual locations, a twofold sampling strategy was implemented. The first sample area was designed to monitor the effects of downslope movement on lithic artifacts. Many artifact concentrations at this site are located on or adjacent to sloping sandstone slickrock; many appear to have moved downslope from deflating deposits. As a consequence, many such concentrations have questionable locational integrity. Additionally, the effects of colluvial transport over a sandstone surface can influence the overall morphology of such assemblages in ways not yet fully understood. These effects should be apparent in the overall size of the artifacts composing the assemblage and also in the edge morphology of the artifacts. Such possible downslope movement may be expected to sort artifacts by size and to radically modify the brittle edges of lithic materials, possibly creating apparent utilized or retouched edges. Since the higher eastern portion of the mesa top contained artifactual materials in apparently more stable sand deposits adjacent to those more westerly, downslope deposits located on bedrock, a transect was chosen which included the higher eastern sand deposits and proceeded downslope to the west, across sandstone bedrock, towards the mesa edge. This transect consisted of an 8-m wide by 90 m long, east-west unit, nominated as Unit 1 (Figure 6.31).

6.7.4 Collection Units

Approximately 2,370 artifacts were located in the 720-m^2 mesa top transect. The transect appears to have crosscut several surface concentrations located on both bedrock and sedimented areas. The artifacts included corner-notched dart and side-notched indented base dart points.

Figure 6.31 LA 27018, Abiquiu Archaeological Study, ACOE, 1989.



The second sampling component, Unit 2, was located in deposits at the base of the escarpment; it was implemented to evaluate whether the artifacts here resulted from erosion and transport from the mesa top or from in situ deposition. A 30 x 20 m surface collection was implemented over a discrete lithic concentration, situated approximately 30 m northwest of the sandstone bluff. This area was located on sandy deposits in a small, isolated copse of pinyon and juniper and was not susceptible to current downslope erosion. The southwestern portion of this concentration was crosscut by a shallow, intermittent drainage; the west edge was located at a low, cobble-covered escarpment which marked the head of a short, entrenched, feeder drainage to Comanche Canyon.

Approximately 644 lithic artifacts were surface collected in Unit 2. The majority of these was located in an approximately 100-m^2 area, situated mostly on stable sandy deposits. The western edge of the concentration, however, was located on large gravel deposits at the edge of the low escarpment. Included in the surface artifacts was one PaleoIndian or Early Archaic projectile point.

6.7.5 Subsurface Samples and Stratigraphy

Two 1 x 1 m test pits were excavated in this area to assess the integrity of any subsurface deposits. Samples are described in Table 6.22. One pit (144N/12E) was located in an area containing sparse surface artifacts about 3 m northeast of a lithic concentration. This unit was excavated in 10-cm arbitrary levels to a depth of around 50 cm. Materials were screened through 1/4-inch mesh.

Table 6.22 LA 27018 Samples, Abiquiu Archaeological Study, ACOE, 1989.

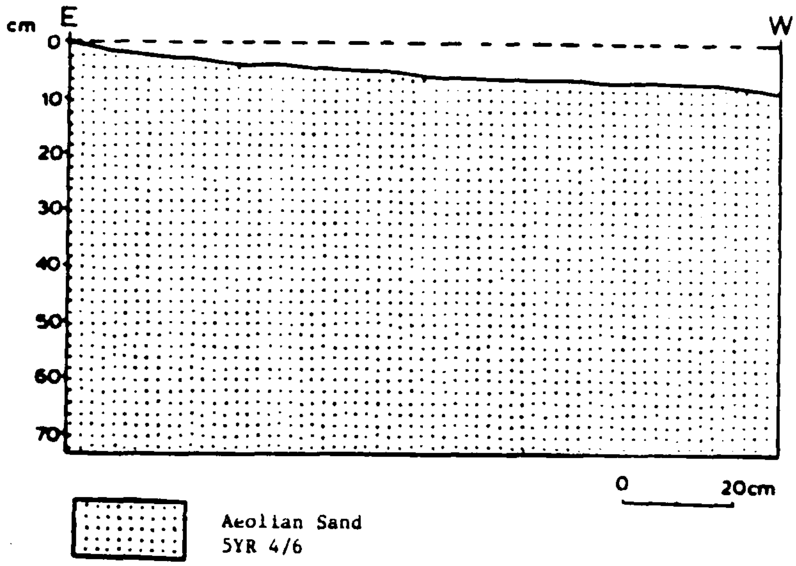
Provenience	Flotation	Pollen	C-14
N137/E6, Level 1	1	1	--
N144/E12, Level 3	1	1	--

Test unit 137N/6E was located within an apparent surface concentration. This unit was excavated to a 30-cm maximum depth. Excavation ceased when feature deposits with archaeomagnetic dating potential were encountered. Materials were screened through two meshes, with 1/4-inch screen above 1/8-inch mesh.

The test pit located outside the lithic concentration (144N/12E) yielded 10 lithic artifacts in four levels. The matrix within the unit consisted of a fine, uniform, aeolian sand with no structure or apparent stratigraphy (Figure 6.32). A few minute flecks of charcoal were present 10 to 20 cm below the modern ground surface, and an extremely thin and diffuse charcoal stain was

present along the east side of the grid at a 20-cm depth. The stain exhibited no apparent integrity.

Figure 6.32 LA 27018, N144/E12, South Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



Test pit 137N/06E contained 120 lithic artifacts in three 10 cm levels. The upper portion of Level 1 consisted of a clean, very fine, colluvially washed sand (Figure 6.33). Below this was a clayey sand or loam. In Level 2 the east side of the grid contained numerous angular, fire-cracked quartzite and sandstone fragments. These were imbedded in a diffuse charcoal stain which contained a few minute flecks of charcoal. Further excavation revealed an apparent hearth feature (Feature 1; Figure 6.34), which seemed to have undergone some erosional disturbance and consisted of an area of bright red and orange clay. This area exhibited no definable shape but probably continued in the adjacent unexcavated grid units. Fire-cracked quartzite and sandstone fragments were located in no apparent pattern on the west edge of the feature. No ash was present above the red oxidized area, and only a few flecks of charcoal were present. This suggested possible erosion of the feature. Since the oxidized area suggested in situ burning, excavation was terminated, and the feature was closed with plastic and backfilled, to protect deposits having potential for archaeomagnetic dating.

6.7.6 Rough Sort and Detailed Lithic Analysis

LA 27018 is an extensive lithic scatter composed of at least three spatially distinct concentrations of artifactual materials. A total of 1,320 m^2 of the surface was subject to intensive surface collection. Surface collection Unit 1 was an 8 x 90 m transect running east to west down the slope on

Figure 6.33 LA 27018, N137/E6, Feature 1, East Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

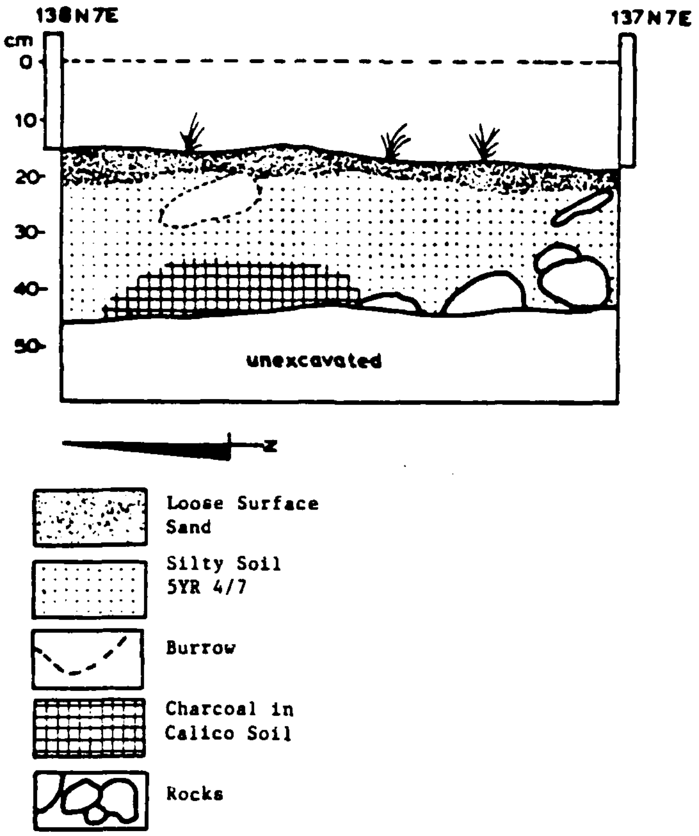
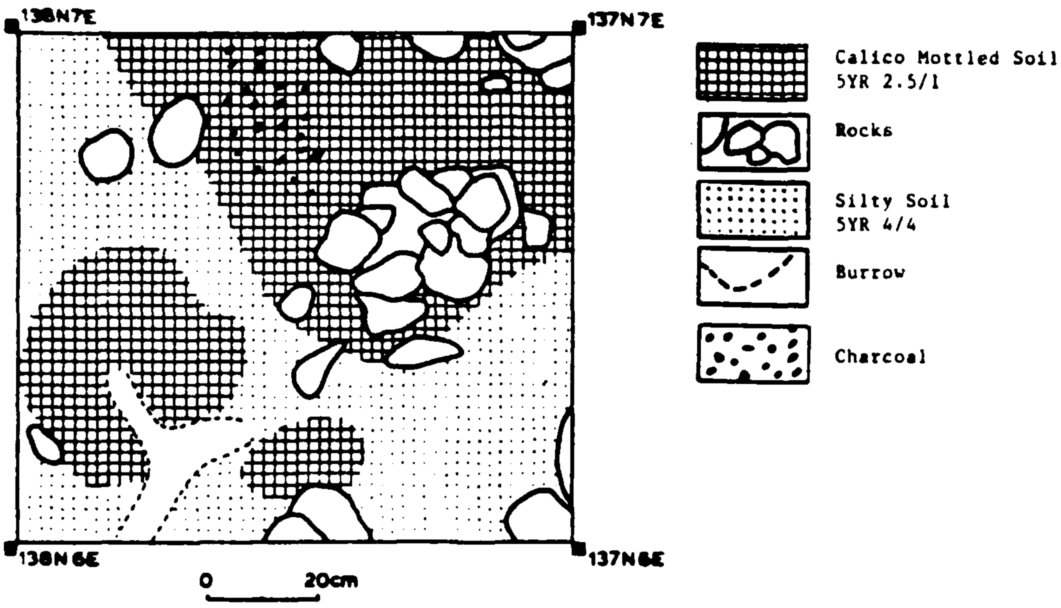


Figure 6.34 LA 27018, N137/E6, Feature 1, Bottom of Level 2, Abiquiu Archaeological Study, ACOE, 1989.



which LA 27018 is situated. This unit was established to monitor possible downslope movement in artifactual materials. A second, 20 x 30 m, surface collection unit (Unit 2) was established to the northwest of collection Unit 1 (Figure 6.31).

LA 27018 has been divided into eight individual provenience units. Six of these are surface proveniences, which were distinguished largely on the basis of variation in surface density, and two are subsurface units. These are shown in Table 6.23. All provenience units within collection Unit 1 extend across the entire north-south breadth of the transect, and the high density stripes are contained within the low density stripes.

Table 6.23 LA 27018 Provenience Units, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Surface Unit	Density	Grid Coordinates
1	1	low	100-107N/131-187E (except Prov. 2 next line)
2	1	mod./high	100-107N/160-168E
3	1	low	100-107N/98-130E (except Prov. 4 next line)
4	1	mod./high	100-107N/104-118E
5	2	low	all Unit 2 except Prov. 6 next line
6	2	high	131-144N/0-7E
7	2	N.A.[1]	subsurface 137N/6E (within Prov. 6)
8	2	N.A.	subsurface 144N/12E (within Prov. 5)

1 N.A. = Not Applicable.

Approximately 3,260 artifacts were collected from LA 27018. A sample of 1,360 artifacts was selected for detailed analysis. This unusually high proportion selected for detailed analysis is largely due to the fact that detailed analyses were required in conjunction with the study of downslope artifact movement at the site (see Chapter 10). The breakdown of the detailed sample, by provenience, is as follows: Provenience 1, 89 artifacts; Provenience 2, 288 artifacts; Provenience 3, 155 artifacts; Provenience 4, 531 artifacts; Provenience 6, 176 artifacts; and Provenience 8, 121 artifacts.

Heat treatment (Table 6.24) on artifacts for LA 27018 is almost entirely limited to Pedernal chert. Approximately 81 percent of all artifacts of this material have been successfully heat treated, while an additional 19 percent have been overtreated or burned. Heat treatment also varies significantly among artifact types. Biface flakes exhibit successful heat treatment in approximately 94 percent of observed cases. Core flakes, in contrast, show successful heat treatment in 74 percent of all cases. Core flakes also appear to be overtreated or burned approximately three times as frequently as do biface flakes (25 percent versus six percent). Unidentified flakes are inter-

mediate between the two flake types in their frequency of heat treatment (84 percent successful treatment). All three cores, along with 72 percent of the bifaces from LA 27018, had been heat treated. Of the 663 heat treated artifacts examined in the detailed analyses, 95 percent had been heat treated in core form and five percent in flake form.

Table 6.24 LA 27018 Heat Treatment by Artifact Type, Pedernal Chert Only, Abiquiu Archaeological Study, ACOE, 1989.

	None		Total Treated		Successful	Unsuccessful		Successful Core	Successful Flake	Total % Successful	Total
	#	%	#	%		#	%				
Miscellaneous	--	--	1	100	1	--	--	--	--	100	1
Biface Flake	42	15	233	85	123	15	6	92	3	94	275
Biface	1	5	18	95	8	5	28	5	--	72	19
Bifacial Core	--	--	1	100	1	--	--	--	--	100	1
Single Platform Core	--	--	2	100	2	--	--	--	--	100	2
Core Flake	249	33	491	67	178	124	25	177	12	74	740
Drill	1	100	--	--	--	--	--	--	--	--	1
Graver	--	--	1	100	1	--	--	--	--	100	1
Heat Spall	1	20	4	80	--	4	100	--	--	--	5
Large Angular Debris	--	--	4	80	--	4	100	--	--	--	4
Pressure Flake	5	7	63	93	--	11	17	47	5	83	68
Projectile Point	--	--	3	100	3	--	--	--	--	100	3
Small Angular Debris	41	39	64	61	17	32	50	14	1	50	105
Unidentified Flake	351	29	844	71	420	127	15	289	8	84	1,195
Unifacially Retouched Flake	4	20	16	80	2	4	25	8	2	75	20
Uniface	--	--	1	100	--	1	100	--	--	--	1
Total	695	28	1,746	72	756	327	19	632	31	81	2,441

6.7.6.1 Provenience 1

Provenience 1 represents those low density grids (zero to four artifacts/m^2) which lie to the east of grid coordinate 131E. The provenience is actually made up of two blocks of grids, 100-107N/131-159E and 100-107N/169-187E, with an intervening interval of higher density grids, Provenience 2.

A total of 312 pieces of chipped stone was collected from the low density grids in Provenience 1, including 300 flakes (96 percent), 10 pieces of angular debris, one biface, and two projectile point fragments (Table 6.25). The most common material is Pedernal chert (72 percent), followed by Polvadera obsidian (16 percent) and quartzitic sandstone (five percent). Small quantities of locally available chert, jasper, quartzite, and silicified wood, as well as Jemez obsidian, are also present (Table 6.26).

Table 6.25 LA 27018 Provenience Summary by Artifact Type, Abiquiu Archaeological Study, ACOE, 1989.

Prove-nience	Biface		Cores		Drill		Flakes		Graver		Large Angular Debris		Miscel-laneous		Projec-tile Point		Small Angular Debris		Uniface		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
1	--	--	--	--	--	--	300	96	--	--	--	--	--	--	2	1	10	3	--	--	312	10
2	2	<1	1	<1	--	--	504	94	--	--	1	<1	4	1	--	--	22	4	1	<1	535	17
3	7	2	--	--	--	--	362	91	--	--	1	<1	3	1	3	1	21	5	--	--	397	12
4	12	1	--	--	1	<1	1,023	93	1	<1	4	<1	2	<1	3	<1	49	4	--	--	1,095	34
5	3	2	2	1	--	--	138	93	--	--	--	--	--	--	1	1	5	3	--	--	149	5
6	9	2	--	--	--	--	566	96	--	--	--	--	--	--	--	--	11	2	1	<1	587	18
7	--	--	--	--	--	--	120	99	--	--	--	--	--	--	--	--	1	1	--	--	121	4
8	--	--	--	--	--	--	10	100	--	--	--	--	--	--	--	--	--	--	--	--	10	<1
Total	33	1	3	<1	1	<1	3,023	94	1	<1	6	<1	9	<1	9	<1	119	4	2	<1	3,206	100

Artifacts manufactured of Pedernal chert are limited to flakes (96 percent) and small angular debris.

The Polvadera obsidian sample from Provenience 1 includes 47 flakes, one piece of angular debris, and two fragmentary projectile points (are broken in two pieces).

Only 17 artifacts of silicified sandstone (all flakes) were collected from Provenience 1.

Casual or expedient tools from Provenience 1 include two Pedernal chert flakes with unidirectional marginal retouch and one with bidirectional retouch. No utilized, unretouched flakes were noted in the analysis. A fragmentary biface blank manufactured of heat treated Pedernal chert was also collected from this area. The single projectile point fragment consists of the basal portion of a stemmed or broadly side-notched dart-sized point, manufactured of Polvadera obsidian. Two fragments of another undiagnostic Polvadera point are also present.

The activities represented in the lithic debris vary somewhat among raw materials. The Pedernal chert sample is dominated by faceted platform flakes indicative of core reduction; the cortex data indicate some primary as well as secondary reduction. The chert biface blank, in combination with retouched platforms, reflects a limited amount of biface manufacture. The presence of use damage on at least one platform also suggests renewal of finished tools in this location. In contrast, the Polvadera obsidian sample is dominated by biface manufacture and renewal debris although no discarded early-stage biface fragments were collected. This may indicate a greater emphasis on biface

Table 6.26 LA 27018 Provenience Summary by Material Type, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Miscellaneous #	Miscellaneous %	Brown Jasper #	Brown Jasper %	Fossiliferous Green Chert #	Fossiliferous Green Chert %	Green Chert #	Green Chert %	Jemez Obsidian #	Jemez Obsidian %	Miscellaneous Chert #	Miscellaneous Chert %	Morrison Green Chert #	Morrison Green Chert %	Moss Jasper #	Moss Jasper %	Nacimiento #	Nacimiento %	Pedernal Chert #	Pedernal Chert %	Polvadera Obsidian #	Polvadera Obsidian %	Quartzitic Sandstone #	Quartzitic Sandstone %	Quartzite #	Quartzite %	Silicified Wood #	Silicified Wood %	Vitrophyre #	Vitrophyre %	Total #	Total %
1	2	1	9	3	1	<1	--	--	3	1	1	<1	1	<1	1	<1	--	--	226	72	50	16	17	5	--	--	1	<1	--	--	312	10
2	5	1	2	<1	2	<1	--	--	4	1	--	--	3	1	2	<1	--	--	448	84	31	6	30	6	--	--	6	1	2	<1	535	17
3	3	1	1	<1	--	--	--	--	8	2	--	--	6	2	--	--	--	--	245	62	122	31	10	3	--	--	1	<1	1	<1	397	12
4	10	1	10	1	--	--	1	<1	5	<1	--	--	3	<1	--	--	1	<1	685	63	221	20	156	14	2	<1	1	<1	--	--	1,095	34
5	--	--	--	--	--	--	--	--	1	1	--	--	--	--	--	--	--	--	142	95	4	3	2	1	--	--	--	--	--	--	149	5
6	--	--	1	<1	--	--	--	--	--	--	--	--	--	--	--	--	1	<1	577	98	3	<1	2	<1	3	1	--	--	--	--	587	18
7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	121	100	--	--	--	--	--	--	--	--	--	--	121	4
8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	90	1	10	--	--	--	--	--	--	--	--	10	<1
Total	20	1	23	1	3	<1	1	<1	21	1	1	<1	13	<1	3	<1	2	<1	2,453	77	432	13	217	7	5	<1	9	<1	3	<1	3,206	100

renewal as opposed to manufacture. The quartzitic sandstone debris, though scanty, appears to reflect primary and secondary core reduction. The presence of three retouched flakes probably reflects additional processing or manufacture using nonlithic materials.

6.7.6.2 Provenience 2

Results of the downhill study of collection Unit 1 indicate that the spatial concentration of materials within Provenience 2 represents a more or less intact surface deposit from which the more mobile (small and flat) objects have been removed by water action (see Chapter 10). This provenience yielded a total of 535 artifacts, including 504 flakes (94 percent), 22 pieces of angular debris, one core, two bifaces, and one uniface. The relative frequency of Pedernal chert (84 percent) is somewhat higher than in Provenience 1, and the proportion of Polvadera obsidian is lower (six percent). Quartzitic sandstone (six percent) and a variety of cryptocrystalline materials, Jemez obsidian, and vitrophyre make up the remainder of the assemblage.

Pedernal chert artifacts from Provenience 2 include 421 flakes, two biface fragments, one core, and 22 pieces of angular debris.

Polvadera obsidian artifacts from Provenience 2 include 29 flakes. Only three percent of these flakes have any dorsal cortex, and none has more than 50 percent.

Thirty flakes of quartzitic sandstone were collected from Provenience 2. Fourteen percent of these have traces of dorsal cortex, and one piece has 100 percent dorsal cortex.

Three unidirectionally retouched flakes of Pedernal chert were collected from Provenience 2. Formal tools include a complete biface blank of vitrophyre and a fragmentary biface blank of Pedernal chert exhibiting remnant thermal surfaces which indicate heat treatment in flake form.

Provenience 2 presents a similar overall picture to Provenience 1 with some interesting differences. Pedernal chert is dominated by primary and secondary core reduction debris, with a substantial component of used and prepared retouched platforms and a fragmentary biface blank indicating biface manufacture and renewal. A limited expedient tool component is also represented by three marginally retouched flakes of this material. The small sample of quartzitic sandstone artifacts shows a mix of biface and core reduction similar to that exhibited by Pedernal chert.

The Polvadera obsidian sample has a somewhat lower proportion of retouched platforms than Provenience 1 although it is still relatively highly biased towards biface reduction debris. The lower frequency of retouched platforms could be due to actual differences in the kinds of activities responsible for the formation of high and low density deposits, or it could be made up for in the high proportion of collapsed platforms in Provenience 2. The spatial analysis suggests a third explanation, however. Chapter 10 suggests that a large proportion of the smallest and flattest flakes had been

winnowed out of the high density deposit around Provenience 2 by water action. Furthermore, it was observed that biface flakes and fragments formed a major proportion of the smallest and thinnest group of artifacts at LA 27018. Thus, it is likely that the differences in 1) the overall proportion of obsidian and 2) the relative percentage of obsidian biface flakes (flakes with retouched platforms) between Proveniences 1 and 2 can be accounted for by the action of hydrological forces in transporting small and thin flakes from Provenience 2 into parts of Provenience 1.

6.7.6.3 Provenience 3

Like Provenience 1, Provenience 3 represents a set of low density grids lying uphill or downhill from a high density concentration. Provenience 3 produced a total of 397 chipped stone artifacts, including 362 flakes, 21 pieces of angular debris, seven bifaces, three projectile point fragments, one large angular debris, and three miscellaneous. Pedernal chert accounts for 62 percent of the total while Polvadera obsidian makes up 31 percent. The remaining artifacts are manufactured of quartzitic sandstone, various cryptocrystalline materials, Jemez obsidian, vitrophyre, and milky quartz. Only the two most common materials are discussed below. A single fragment of a quartzite mano was also recovered from this provenience.

Of the 245 artifacts of Pedernal chert collected from Provenience 3, 222 (91 percent) are flakes, 18 are angular debris, and two are bifaces.

The Polvadera obsidian sample consists of 113 flakes, four pieces of angular debris, three biface fragments, and three projectile fragments.

Three informal tools were collected from Provenience 3: unidirectionally retouched flakes of Pedernal and Morrison Formation cherts, and a Polvadera obsidian flake with bidirectional retouch (Appendix F). None shows obvious use damage. A much larger sample of formal tools (11, or three percent of the total) was collected. All are fragments of bifacial tools. Two fragmentary early preforms and one fragment of a completed biface are manufactured of obsidian. Another fragmentary early stage preform and a fragment of a finished biface are manufactured of heat treated Pedernal chert, the latter specimen showing evidence of heat treatment in flake or biface form. Finally, two biface preform fragments of Morrison Formation chert were collected.

Two projectile point fragments from Provenience 3 are made of Polvadera and one of Cerro del Medio obsidian. Two are basal fragments of broadly side-notched or stemmed lanceolate dart points. The other is the proximal half of a basally and side-notched palmate dart point, similar to but larger than specimens typically termed Navajo points.

Activities represented in the lithic debris from Provenience 3 span the range of reduction techniques observed for other sites in the study area. Both primary and secondary core reduction are represented by abundant flakes with faceted and cortical platforms although the relative infrequency of cortex suggests an emphasis on later core reduction stages. Retouched and prepared or use-damaged platforms are relatively common in both Pedernal chert and Polvadera obsidian within Provenience 3, indicating a relatively strong

biface manufacture and maintenance component in the formation of the assemblage. Early and middle stage bifaces, probably manufacturing rejects, are present for major material types -- unlike the situation in Proveniences 1 and 2. This suggests that the full range of formal tool manufacture activities may be represented in both materials. In addition, the evidence of use damage on retouched platforms and the presence of a broken projectile point suggest that the maintenance and/or replacement of formal tools contributed to the formation of this assemblage, or at least the Polvadera obsidian component. A component of nonlithic processing activities is also probably represented by the marginally retouched flake tools.

The presence of two unfinished biface fragments of Morrison Formation chert is interesting in light of the rarity of this material in the assemblage as a whole. Only seven flakes of this material (including one retouched specimen) was collected in Proveniences 3 and 4; of these, one has a faceted and one a retouched platform. This flake/tool ratio contrasts markedly with the figures for Polvadera obsidian and Pedernal chert, and these data suggest that the Morrison chert biface or bifaces were transported, partially finished, into this location, and not manufactured on the spot.

6.7.6.4 Provenience 4

This provenience represents a series of moderate to high density grids located within Provenience 3, or the western half of collection Unit 1. A total of 1,095 artifacts, including 1,023 flakes (93 percent), 53 pieces of angular debris, 12 biface fragments, three projectile point fragments, one graver, two miscellaneous, and a drill tip, was collected. Sixty-three percent of these artifacts are of Pedernal chert, 20 percent are of Polvadera obsidian, and 14 percent are of quartzitic sandstone. The remainder of the sample includes five pieces of Jemez obsidian and a number of cherts and silicified woods which are likely to be available in the local gravels.

The sample of Pedernal chert artifacts from Provenience 4 includes 631 flakes, 43 pieces of angular debris, seven bifaces, two projectile point fragments, a graver, and a drill tip.

The Polvadera obsidian sample from Provenience 4 includes 212 flakes, five pieces of angular debris, two bifaces, and a projectile point fragment.

The quartzitic sandstone artifacts from Provenience 4 include 151 flakes, two pieces of angular debris, and two biface fragments.

Casual or informal tools from Provenience 4 include three unidirectionally retouched flakes (one each of Pedernal chert, Polvadera obsidian, and Jemez obsidian), and one flake with bidirectional marginal retouch (of Polvadera obsidian). Formal tools of Pedernal chert include four early stage biface preform fragments and four fragments of finished bifaces. Two of the finished bifaces show signs of having been heat treated after removal of the original flake blank from the core. In addition, two point fragments are manufactured from Pedernal chert. One is the basal portion of a lanceolate, stemmed, or broadly side-notched dart point, and the other is the base of a palmate, corner-notched dart point, possibly of the En Medio type. Two addi-

tional early preform fragments and one biface blank fragment are made of quartzitic sandstone. Polvadera obsidian formal tools include an early stage preform fragment, a portion of a biface blank, and the basal portion of a large, corner-notched En Medio type point. The tip of a small, bifacial drill, manufactured of heat treated silicified wood, was also recovered from this provenience.

Like Provenience 3, Provenience 4 contains lithic materials attributable to the entire range of manufacture activities, from primary and secondary core reduction through bifacial tool manufacture. All three material groups discussed include both flakes with retouched platforms and broken, unfinished bifaces which probably are manufacturing failures. Evidence of use damage on platforms, indicative of renewal of utilized formal tools, is also present for both Pedernal chert and Polvadera obsidian. The presence of broken bifacial tools of these materials suggests that the renewal and replacement of portable, curated spears, such as projectile weapons, may have taken place in this location, in addition to other manufacturing activities. No evidence of this activity is present in the quartzitic sandstone component, however. As in the other proveniences, there is a minor component of informal, probably expedient tools which indicates some variety of on-the-spot processing and manufacture involving nonlithic materials.

It is likely that, as with Proveniences 1 and 2, the differences in 1) the overall frequency of Polvadera obsidian and 2) the frequency of biface reduction debris (retouched platforms) between Proveniences 3 and 4 is attributable to the winnowing actions of water moving smaller items downhill from the latter provenience into the former. The relatively larger proportion of formal tools (one percent versus 0.3 percent) and bifaces (two percent versus one percent) in the less dense areas is not consistent with this result. This pattern of overrepresentation of formal tools in less dense areas has been noted for other sites as well. It is possible that this reflects a different pattern of discard for formal artifacts, which make up a more generalized, background pattern, compared with debitage, which, if not intentionally cleaned up, tends to be deposited in highly concentrated masses where stone working takes place.

6.7.6.5 Provenience 5

Provenience 5 represents the low density (fewer than five artifacts/m^2) grids within collection Unit 2. A total of 149 artifacts was collected from the grids which make up this provenience, including 138 flakes, three biface fragments, two cores, one projectile point, and five pieces of angular debris. Pedernal chert makes up 95 percent of the assemblage; the remainder includes small quantities of Polvadera obsidian, quartzitic sandstone, and Jemez obsidian.

Artifacts manufactured of Pedernal chert include 132 flakes, five pieces of angular debris, two biface fragments, and one projectile point.

The Polvadera obsidian sample from Provenience 5 consists of only three flakes and one biface fragment.

There are no marginally retouched or utilized, unretouched tools recorded for Provenience 5. Formal tools include two early stage biface preform fragments of heat treated Pedernal chert and a biface blank fragment manufactured of Polvadera obsidian. The single projectile point fragment (27018-16), manufactured of heat treated Pedernal chert, is the basal two-thirds of a stemmed, basally ground lanceolate point found in grid N149.85/E14.30. This specimen is typed as a Jay point (Chapter 8, Figure 8.6J) and suggests Early Archaic occupation.

The chipped stone assemblage from Provenience 5 differs sharply from the assemblages of the four proveniences in collection Unit 1. It is heavily dominated by Pedernal chert and by secondary and some primary core reduction debris. Biface manufacture is represented by a relatively small proportion of retouched platforms and by several unfinished biface fragments. The renewal of finished formal tools is suggested by the single platform showing evidence of use damage. The very small Polvadera obsidian assemblage is primarily indicative of biface manufacture. There are no casually retouched or utilized flakes indicative of nonlithic processing or manufacture activities.

6.7.6.6 Provenience 6

This provenience includes a block of grids within collection Unit 2 which exhibited moderate to high surface artifact densities (greater than five artifacts/m^2). Of a total of 587 artifacts from this provenience, 566 (96 percent) are flakes, 11 are pieces of small angular debris, and 11 are formal tools (nine bifaces and one uniface). Approximately 98 percent of the assemblage is of Pedernal chert with much smaller quantities of Polvadera obsidian, quartzitic sandstone, jasper, quartzite, and Nacimiento chert making up the remainder. Only the Pedernal chert assemblage is discussed in detail.

Artifacts from Provenience 5 manufactured of Pedernal chert include 557 flakes, 11 pieces of angular debris, two unifaces, and eight bifaces.

Eight flakes of Pedernal chert exhibit unidirectional marginal retouch. Another flake shows evidence of bidirectional use wear. Most of the formal tools are manufactured of Pedernal chert. Of four early stage biface preforms, two show signs of having been heat treated in flake form and two of heat treatment at the core stage. The single late stage preform appears to have been heat treated in flake form. One of the two Pedernal chert biface blanks is untreated while the other has remnant thermal surfaces on both faces, indicating heat treatment in flake or partially finished form. Two uniface fragments are also manufactured of Pedernal chert, one of heat treated and one of untreated material. A single fragmentary biface blank is manufactured of heat treated Nacimiento chert. No other artifacts of this material were collected from either Provenience 5 or Provenience 6.

The assemblage from Provenience 6 differs strongly from that of Provenience 5 in almost all respects except raw material composition. The relatively high proportion of retouched platforms and large number of unfinished early stage biface fragments indicate that biface working played an important role in the formation of this assemblage. Platform damage data, while sparse, indicate both resharpening/renewal and manufacture of late stage

artifacts, although no finished bifacial tools of Pedernal chert were collected. The low overall frequency of cortex suggests that core reduction debris may be primarily attributable to later reduction stages. An unusually large number of casually retouched and utilized artifacts was collected from this provenience, which suggests that the processing of nonlithic materials may have been slightly more important here than in other portions of the site. The presence of two unifaces and possible uniface renewal flakes (with unidirectionally retouched platforms) suggests that activities involving intensive use of scrapers were carried out in this area as well. In contrast to the situation with Pedernal chert bifaces, there is no evidence that the single Nacimiento chert biface was worked in the immediate vicinity, and it is likely that this artifact was transported to the site in near its present form.

6.7.6.7 Provenience 7

Provenience 7 is a test pit situated within Provenience 6. This pit yielded a total of 121 artifacts (120 flakes and one piece of angular debris) from three artificial or perhaps two natural levels. All are manufactured of Pedernal chert.

The assemblage from Provenience 7 is unique for LA 27018 in that it is dominated by debris with attributes such as retouched platforms, which are indicative of biface working. Although the platform damage evidence points directly only to renewal of utilized bifaces (i.e., use damage), it is likely that biface manufacture is represented as well. What core reduction debris is represented appears to relate primarily to the later stages of reduction, as indicated by the relative rarity of cortex. Since no clear stratigraphic breaks were noted during excavation of the test unit, it may be that this unit in a sense samples a small area of intensive biface working within Provenience 6.

6.7.6.8 Provenience 8

This provenience is another test unit, located within Provenience 5, the less dense portion of collection Unit 2. Only 10 flakes, nine of Pedernal chert and one of Polvadera obsidian, were recovered from this test pit. All of the chert flakes are noncortical, while the single obsidian flake has a small amount of dorsal cortex. The chert flakes include three with faceted platforms and one with a retouched platform. The obsidian flake has a faceted platform. No platform damage, utilization, or retouch was observed on the artifacts from this provenience. This assemblage is too small to merit much discussion of the kinds of manufacturing activities represented. It is entirely consistent, however, with the larger surface assemblage from Provenience 5.

6.7.6.9 Lithic Analysis Summary and Site Occupational History

The lithic data suggest that LA 27018 consists of at least three distinct concentrations: the high density area within Unit 1, Provenience 2, and associated low density scatter; the high density area within Unit 1, Provenience 4, and associated low density scatter; and Unit 2, Proveniences 5 and 6. Each of these concentrations shows a somewhat different mix of raw mate-

rial types and debris representing different lithic manufacturing activities. Both concentrations within collection Unit 1 are dominated by Pedernal chert, but the one represented by Proveniences 3 and 4 exhibits a significantly higher relative frequency of Polvadera obsidian and a concomitantly lower proportion of quartzitic sandstone than does the concentration represented by Proveniences 1 and 2. The former cluster also shows a much greater emphasis on biface manufacture, using all three major material types, than does the latter, which exhibits limited evidence attesting primarily to the renewal of finished tools. Proveniences 5 and 6 are also quite distinctive. Both areas are heavily dominated by Pedernal chert. The dominant activity in the assemblage from Provenience 5 is core reduction, while biface manufacture and renewal played a relatively more important role in the formation of the assemblage from Provenience 6. The frequency of retouched flakes and nonbiface formal tools indicated that processing of nonlithic materials was, from an assemblage formation standpoint at least, more important in Provenience 6 than in any other area within LA 27018.

The relationship between lithic density and time period of occupation is unclear. All of the dated nontool obsidian was selected from the west half of Unit 1, and the six dated obsidian points were also from Unit 1 (see section 8.5.6). Thus, the evidence for intensive San Jose and Armijo Phase and Developmental Period occupations based on obsidian hydration dating is relevant only for Unit 1. Two of the cross-dated nonobsidian points (dating to the San Jose through En Medio Phases and to Late Developmental Period) are also from Unit 1. The only date for Unit 2 is from the Jay point indicating Early Archaic occupation. Given the mix of dates in Unit 1, it would be unwise to interpret Unit 2 as single component Early Archaic. Indications from Unit 1 and other Abiquiu Reservoir sites suggest that many of the lithic concentrations are multicomponent (see section 9.2).

The analysis of size and shape variation across the downhill slope of collection Unit 1 demonstrates that Proveniences 2 and 4 represent in-place concentrations, from which particularly small and flat items have been selectively removed by water action. This may explain most of the differences between the high and low density proveniences within collection Unit 1, especially the higher percentages of small biface flakes and obsidian in the latter areas. Postdepositional processes probably cannot explain the differences between Proveniences 5 and 6 within collection Unit 2, however, since this unit was situated in a relatively level and intact area. The high density areas within this collection unit might represent a distinct activity or temporal component involving biface manufacture and nonlithic processing activities which is superimposed on the more generalized background scatter represented in the low density grids.

The presence of exotic or rare materials at LA 27018 deserves some discussion. Three bifaces recovered from this site are manufactured of unusual lithic materials: Morrison and Nacimiento Formation cherts. These artifacts are accompanied by a very small number of flakes of these materials, certainly too few to argue for their manufacture on the spot. These three specimens were probably transported to the site in partially completed form. This pattern stands in strong contrast to that exhibited at LA 25328, where the rare raw materials are found primarily as flakes. Although all these materi-

als may be available as cobbles in gravel deposits in the Abiquiu area, it is possible that patterns of the kind described here reflect different raw material uses associated with obtaining materials locally (the LA 25328 pattern) versus at more distant source areas (the LA 27018 pattern).

An additional technological observation may be made on the assemblages from LA 27018. Unidirectionally retouched platforms are relatively common in certain assemblages at this site, particularly from Proveniences 3 and 4. However, the frequency of this type of platform preparation does not correlate with the presence of unifaces: Provenience 6, which yielded the only unifaces recovered from the site, has a relatively low proportion of unidirectionally retouched platforms. Instead, this kind of platform preparation seems associated with early stages of biface manufacture at LA 27018. Based on these patterns, it appears that unidirectional platform retouch is not always associated with the manufacture or renewal of unifacial artifacts, but that it may also represent a kind of specialized platform preparation technique used in conjunction with biface manufacture.

6.7.7 Summary

This project recovered approximately 3,000 artifacts from the surface of 1,320 m^2. This constitutes an areal sample of far less than one percent of this immense lithic scatter. The artifacts include nine projectile points from the early PaleoIndian and Archaic time periods. Additionally, a late arrow point was noted but not collected at the site. Two test pits at the base of the upper mesa indicate that important subsurface in situ deposits are present in this area. Chapter 7 gives more details on obsidian hydration results and site occupational history.

6.7.8 Recommendations

The boundaries of this immense site should be determined by mapping and collection. Alluviated areas between loci 1 and 2 should be tested extensively. Feature 1 should be dated by archaeomagnetic samples. The historical road should be recorded.

6.8 LA 27020

6.8.1 Physiographic Setting

This large, multicomponent site is located on top of a west sloping, east-west trending mesa at an elevation of 6290 to 6330 feet. The southern edge of the mesa has been deeply and vertically incised by the west flowing Comanche Canyon drainage. A major feeder drainage to Comanche Canyon is located below the mesa's northern vertical bluff. This feeder canyon joins Comanche Canyon west of the site area forming a western vertical escarpment. The two deeply entrenched drainages have carved a wedge or triangular mesa upon which site LA 27020 sits. Comanche Canyon enters the Rio Chama 1,650 m to the west. The mesa top consists of sandstone slickrock which occasionally exhibits a thin veneer of small gravels and aeolian sands.

6.8.2 Previous Work

The original survey (Schaafsma 1976:70, 73, 97) described the site as a seventeenth century Navajo structure with an associated 30 x 10 m lithic and ceramic scatter. Beal's (1980:29-30) survey failed to relocate it. An isolated hearth feature was also located 40 m north of the structure. A revisitation in 1982 (Reed et al. 1982:22, 100-101) additionally reported that the site was part of an extensive lithic scatter located on the mesa top.

6.8.3 Field Methods

An examination of the site area during this project revealed an extensive but diffuse scatter of lithic artifacts along the top of the mesa, continuing north and east for an undetermined distance greater than 1,000 m. Additional historic usage of the site area was represented by a series of very old, axe-cut, brush fences. The fences appear to run perpendicular to the long axis of the mesa (i.e., WNW/ESE). A large, very recent fire hearth is present upslope and 60 m east of the main site area. This clearly more recent usage of the site area was also evident on the Piedre Lumbre structure. Modifications to the southeastern wall of the structure suggested the later construction of a hearth from materials scavenged from the structure. The hearth reported north of the structure by the original survey could not be relocated; it may be represented by the large, historic fire hearth to the east.

6.8.4 Collection Units

A 20 x 45 m, east-west oriented surface collection with the southwest corner (MAI datum) located at 100N/100E was carried out (Figure 6.35). The western end of this unit contained the Piedre Lumbre structure, the earlier survey's datum, and associated artifact scatter, while the eastern end was located in a diffuse lithic scatter typical of the mesa surface. The western end of the transect was located on sandstone slickrock and shallow sand while the eastern end was located almost entirely on bedrock.

The 900-m^2 surface collection yielded approximately 385 artifacts. These included 39 micaceous-slipped Valdito sherds, which date approximately from A.D. 1600 to A.D. 1900. The majority of these was located in an 80-m^2 area immediately south and southeast of the structure. The presence of one Wiyo Black-on-white sherd (Mera 1935) represents an isolated occurrence. The single sherd could have been carried to LA 27020 by users of the seventeenth century Valdito wares.

Three hundred and forty-five lithic artifacts were located throughout the collection unit and included five projectile points. Two of these were arrow point forms; both were located southwest of the structure. One was an unknown unifacial form, the other a corner-notched form; both were manufactured from obsidian. The other three points represented earlier Archaic dart points. One was a corner-notched type, and the others were unidentified mid to late Archaic types.

Additional evidence of a later historic component consisted of one soldered can and a low brush fence at the east end of the collection unit.

Figure 6.35 LA 27020, Abiquiu Archaeological Study, ACOE, 1989.

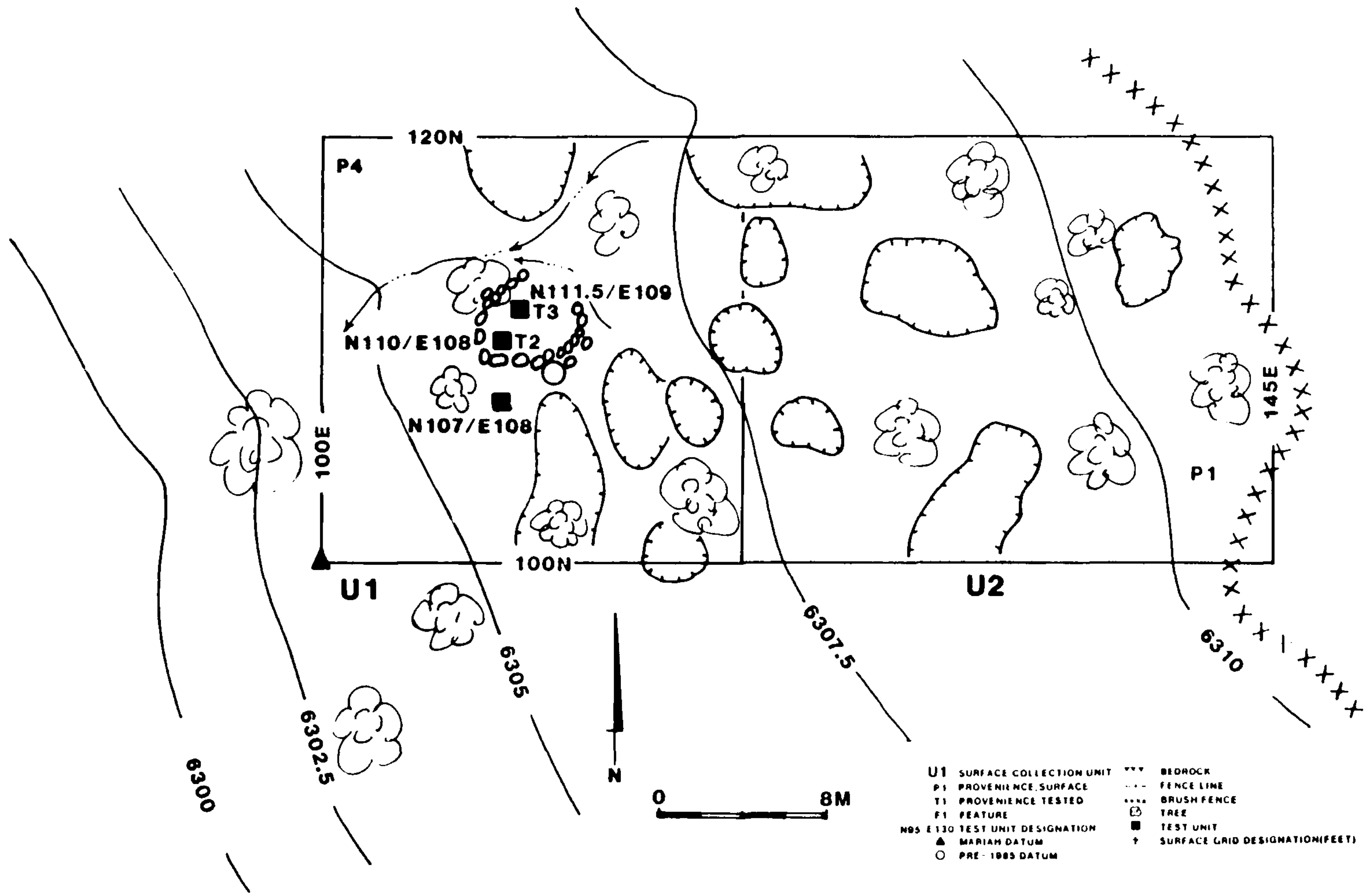
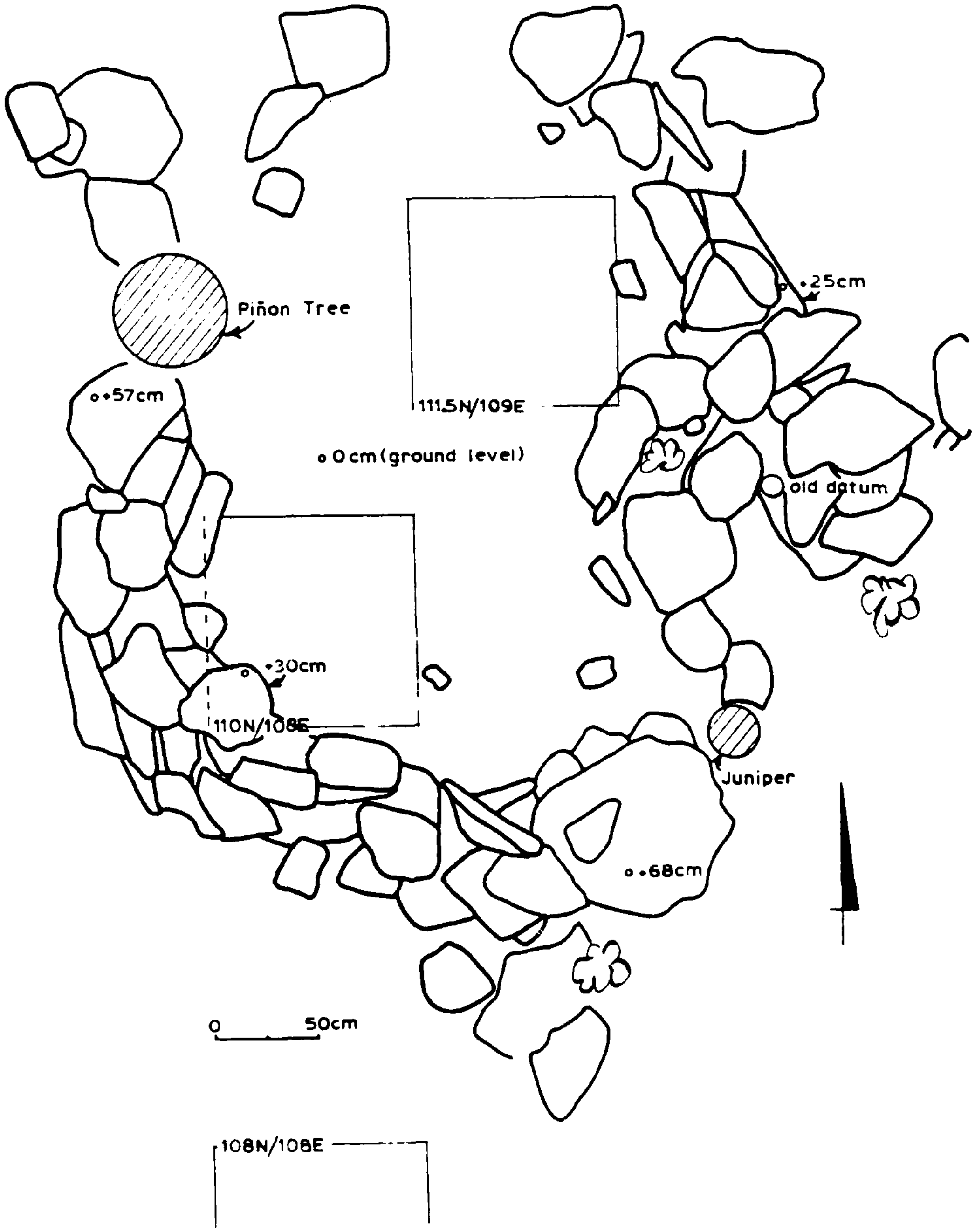


Figure 6.36 LA 27070, Piedra Lumbre Structure, N110-115/E108-109, Surface, Abiquiu Archaeological Study, ACOE, 1989.



The fence was made up of an ephemeral north-south scatter of very old juniper and pinyon branches. It exhibited a wavy rather than linear form and appeared to be influenced by downslope erosion. At no point did the fence exceed a one-branch height. It probably dates to the nineteenth century or earlier.

6.8.5 Subsurface Samples and Stratigraphy

Three 1 x 1 m units were excavated in or near the Piedra Lumbre structure (Figure 6.36). Samples are listed in Table 6.27.

Table 6.27 LA 27020 Samples, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
N107/E108, Level 1	--	--	1
N107/E108, Level 2	1[1]	1[2]	1
N110/E108, Level 1	1	1	1[3]
N111.5/E109, Level 1	1	1	1[3]

1 See Appendix C for results.

2 See Appendix D for results.

3 See Table 6.31 for dates.

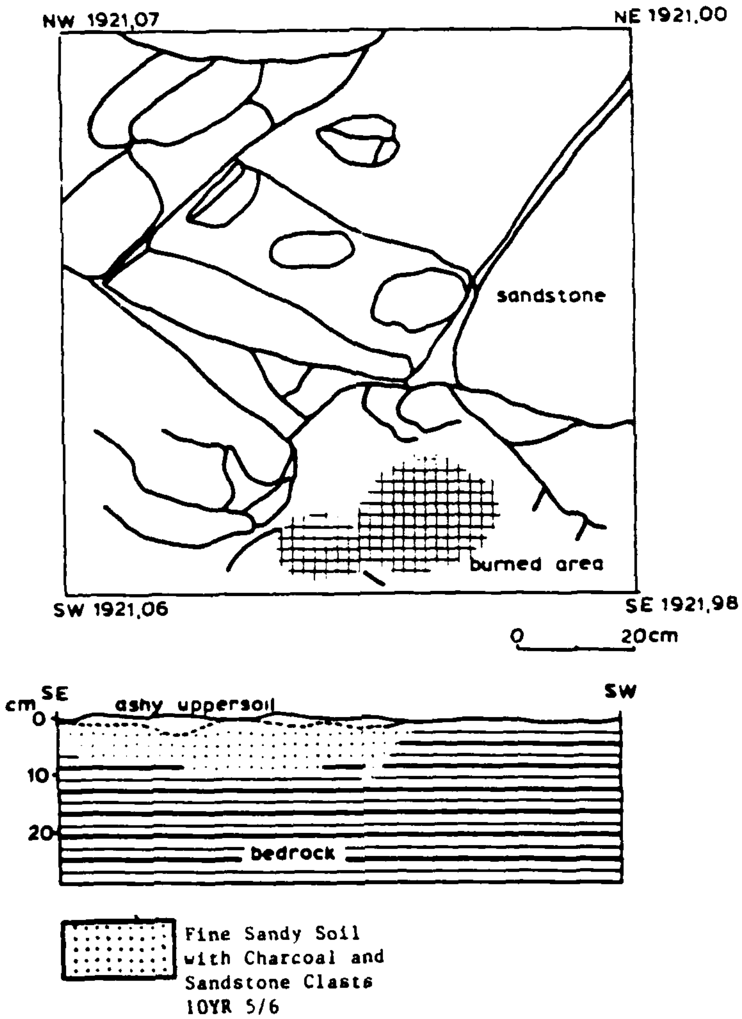
This was a 3.5 x 2 m (interior dimensions) oval with a north-south orientation. It was constructed of dry-laid, unshaped, sandstone slabs. The wall height averaged 30 cm and did not exceed 68 cm. A large, living pinyon was present in the western wall; a possible door was present in the southeast side. This area appeared to be disturbed and contained a recent exterior hearth.

Three 1 x 1 m units were excavated in or near the structure. Grid 107N/108E was located to evaluate an area containing ash, ceramics, and lithics just to the south of the structure. Materials were screened through 1/4-inch mesh. A thin veneer of sand was present in this a ea, and excavation reached a maximum 10-cm depth; a burned, basin-shaped bedrock depression formed the bottom of the unit (Figure 6.37).

The test pit encountered bedrock within 1 to 10 cm. When present, deposits consisted of an ashy sand containing burned and unburned sandstone fragments. Eighteen Valdito sherds were present in the shallow subsurface sand deposits. A burned sandstone area underlay the unit; it probably was an exterior hearth.

Grids 110N/108E and 111.5N/109E were excavated within the structure to test the depth of fill. Materials were screened through 1/4-inch mesh. Grid

Figure 6.37 LA 27020, N107/E108, Plan View and South Wall Profile at Bottom of Surface Level, Abiquiu Archaeological Study, ACOE, 1989.



110N/108E was located along the wall in the southwest corner of the structure (Figure 6.38). This unit was excavated to an 11-cm maximum depth (Figure 6.39).

Excavation encountered bedrock 2 to 10 cm below the surface. Fill in the top 3 cm consisted of pine duff and pack rat midden debris. A yellowish brown, aeolian sand with friable sandstone spalls was present below the duff. Small chunks of charcoal were present throughout the fill, and lithics, bones, and probable Valdito sherds were recovered. No evidence of a prepared floor was present.

Grid 111.5N/109E was located near the center of the structure and was excavated to 20-cm depth. This unit was opposite an opening or door in the structure's southeast wall and was considered a likely location for a hearth feature or activity area. This unit was located on a half-meter coordinate in order to excavate an entire 1-m^2 unit while avoiding a wall.

Excavation encountered a fill which extended to 20 cm depth (Figures 6.40 and 6.41). Ephemeral ash was present in the upper level and appeared to have eroded from the modern hearth. Five lithics, a toy, and two ceramic artifacts were present in the upper 10-cm level. No additional features or floor was definable.

6.8.6 Lithic Analysis

LA 27020 is a large, multicomponent site which is represented by an extensive, diffuse lithic scatter; a possible exterior hearth; a Piedre Lumbre structure; historic brush fences; and a post-Piedre Lumbre hearth intruded into the structure rubble. Projectile points recovered from the site date from early Archaic to Anasazi times. A 20 x 45 m surface collection unit was placed with an east-west orientation. The west end of this unit contained the Piedre Lumbre structure and an associated lithic scatter, while the east end represented the background lithic scatter. Lithic, ceramic, and historic artifacts were recovered from the site.

6.8.6.1 Introduction

The surface lithic scatter that was associated with the structure (Provenience 4) was examined separately from the overall background scatter (Provenience 1) to determine if variability in material selection and tool use could be identified. Two subsurface test pits were placed in the structure. Grid unit 110N/108E (Provenience 2) was excavated in the southwest portion while grid unit 111.5N/109E (Province 3) was excavated in the north-central portion of the structure.

A total of 367 lithic artifacts was recovered from the site (Table 6.28). These artifacts included 343 flakes and pieces of small angular debris, six projectile points (including one undiagnostic fragment), six bifaces, one uniface, one drill, nine cores, and one piece of large angular debris. No ground stone artifacts were recovered.

Figure 6.38 LA 27020, N110/E108, Level 2, Bedrock Floor, Abiquiu Archaeological Study, ACOE, 1989.

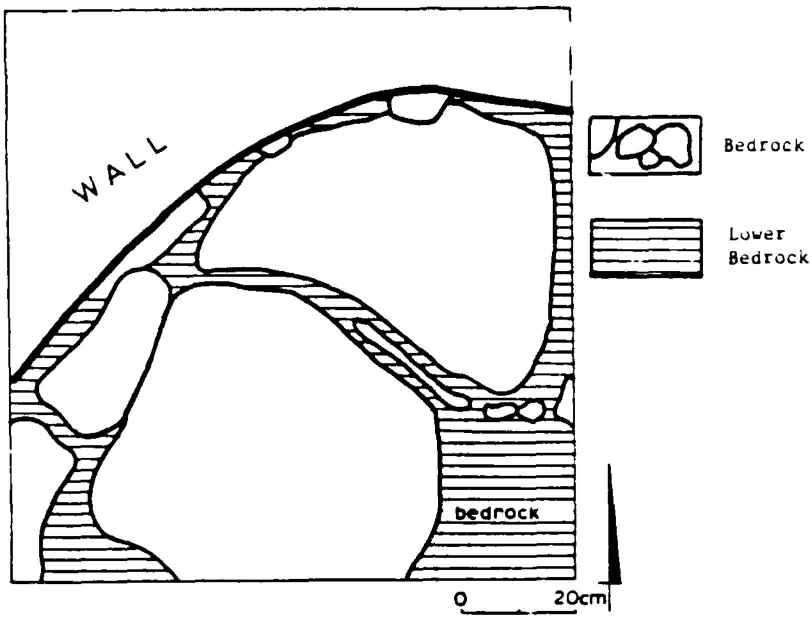


Figure 6.39 LA 27020, N110/E108, West Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

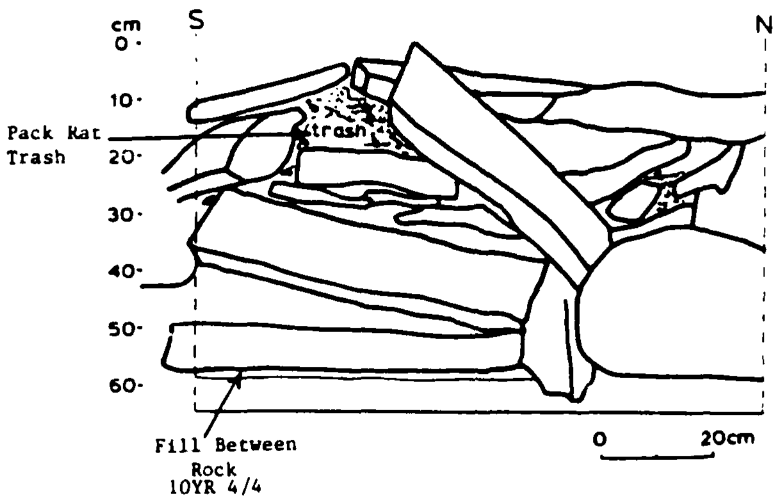


Figure 6.40 LA 27020, N111.5/E109, Top of Level 1, Plan View, Abiquiu Archaeological Study, ACOE, 1989.

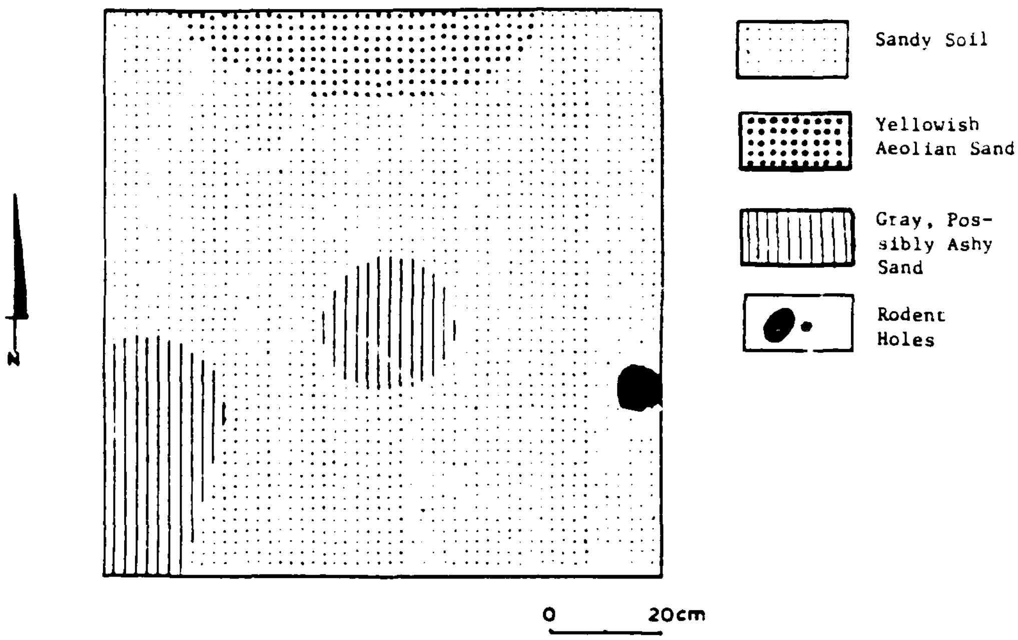


Figure 6.41 LA 27020, N111.5/E109, North Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

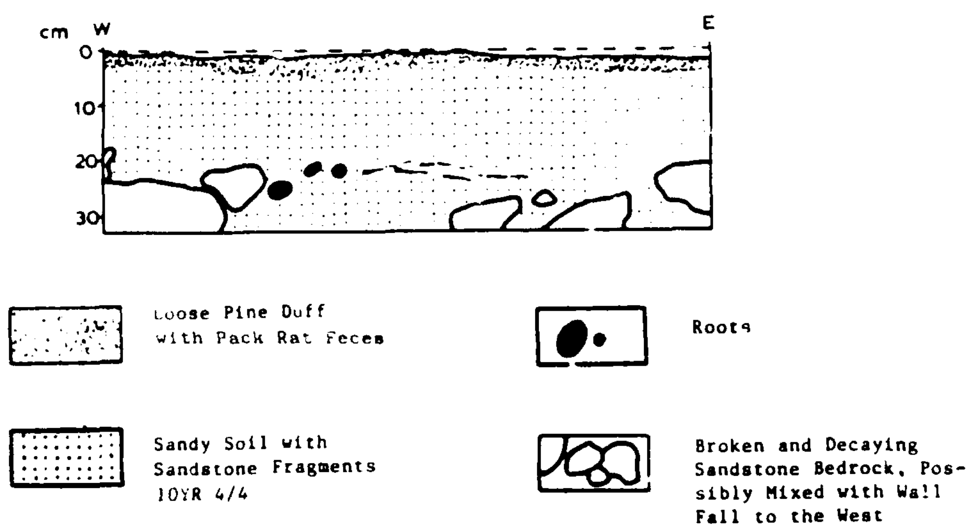


Table 6.28 LA 27020 Artifact Type to Material Type Frequencies (Row Percentage in Parenthesis), Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type								
Material Type	Biface	Core	Drill	Flake	Large Angular Debris	Projec- tile Point	Small Angular Debris	Uniface	Total
Miscellaneous	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1
Jemez Obsidian	--(--)	--(--)	--(--)	2(100)	--(--)	--(--)	--(--)	--(--)	2
Nacimiento Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	1
Pedernal Chert	4(2)	7(3)	1(<1)	224(93)	1(<1)	2(1)	2(1)	1(<1)	242
Polvadera Obsidian	1(1)	1(1)	--(--)	104(94)	--(--)	4(4)	1(1)	--(--)	111
Quartzitic Sandstone	1(13)	1(13)	--(--)	6(75)	--(--)	--(--)	--(--)	--(--)	8
Quartzite	--(--)	--(--)	--(--)	2(100)	--(--)	--(--)	--(--)	--(--)	2
Total	6(2)	9(2)	1(<1)	340(93)	1(<1)	6(2)	3(1)	1(<1)	367

The heat treatment (Table 6.29) is similar to other sites in the study area. Pedernal chert was the only material that exhibited evidence of heat treatment. Within this material class, 175 (72 percent) of the artifacts were treated. Sixty-seven artifacts (28 percent) were not treated. Among the treated Pedernal cherts, 116 artifacts (66 percent) were successfully treated, and 59 artifacts (34 percent) were unsuccessfully treated.

Table 6.29 LA 27020 Heat Treatment to Material Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total / Treated	Unsuccessful	Successful Core	Successful Flake	Total / Successful	Total
Miscellaneous	1	--	--	--	--	--	1
Jemez Obsidian	2	--	--	--	--	--	2
Nacimiento Chert	1	--	--	--	--	--	1
Pedernal Chert	67	175	59	101	15	116	242
Polvadera Obsidian	111	--	--	--	--	--	111
Quartzitic Sandstone	8	--	--	--	--	--	8
Quartzite	2	--	--	--	--	--	2
Total	192	175	59	101	15	116	367

Table 6.30 describes artifact type and heat treatment. This site is markedly different from other sites in the heat treatment of formal tools.

Fifty percent of the bifaces did not exhibit heat treatment. When flakes from bifaces and unifaces were examined, 38 percent and 41 percent, respectively, lacked evidence of heat treatment. These data indicated that two strategies of heat treatment were operating. An examination of the formal tools indicated that the only nonheat treated tools were recovered from the area associated with the structure suggesting that the nonheat strategy may have resulted from the later occupation. An examination of assemblage variability in Proveniences 1 and 4 should provide needed data to determine if two distinct assemblages are represented.

Table 6.30 LA 27020 Heat Treatment to Artifact Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total / Treated	Unsuccessful	Successful Core	Successful Flake	Total / Successful	Total
Biface Flake	2	20	--	19	1	20	22
Biface	1	3	--	1	2	3	4
Bifacial Core	--	2	--	2	--	2	2
Multiplatform Core	1	1	--	1	--	1	2
Core/Pecker	1	--	--	--	--	--	1
Core Flake	36	75	37	34	4	38	111
Drill	--	1	--	1	--	1	1
Multiplatform Exhausted Core	--	1	1	--	--	--	1
Single-Platform Exhausted Core	--	1	--	1	--	1	1
Large Angular Debris	1	--	--	--	--	--	1
Pressure Flake	1	7	2	5	--	5	8
Projectile Point	--	2	--	--	2	2	2
Small Angular Debris	--	2	2	--	--	--	2
Unidentified Flake	19	50	14	32	4	36	69
Unifacially Retouched Flake	4	10	3	5	2	7	14
Uniface	1	--	--	--	--	--	1
Total	67	175	59	101	15	116	242

The following sections describe the lithic assemblage associated with the structure and discuss the background lithic scatter. It was not possible to distinguish the historic lithic scatter on the basis of density. Instead, this scatter was identified on the basis of the ceramic scatter associated with the structure.

6.8.6.2 Provenience 1

Provenience 1 represents the general lithic scatter not associated with the structure. A total of 242 chipped stone artifacts was recovered. These artifacts included 224 flakes, two pieces of small angular debris, four bifaces, three projectile points, one drill, seven cores, and one piece of large angular debris.

The material types that are represented in this assemblage are similar to materials identified on most sites in the study area. This site, however, did exhibit a higher percent of Polvadera obsidian (34 percent, 82 artifacts) and lower percent of Pedernal chert (63 percent, 153 artifacts) than other sites. The remaining five materials made up only three percent of the assemblage (seven artifacts).

Three cores were recovered from Provenience 1. Two were manufactures from Pedernal chert (exhausted single platform core and core/pecker) and one from Polvadera obsidian (exhausted multiplatform core).

When use versus preparation is examined on retouched platforms, tool resharpening rather than manufacture is indicated. Eleven retouched platforms (10 bidirectional and one unidirectional) exhibited evidence of previous tool use. There is strong evidence of the resharpening of Pedernal chert in the presence of 4 platforms with remnant use. The polvadera obsidian exhibited one platform with use.

Nine formal tools were recovered and included four early bifaces, three projectile points, one drill, and one artifact with extensive unidirectional marginal retouch (Appendix F). Four artifacts were manufactured from Polvadera obsidian (three projectile points and one early biface), four were manufactured from Pedernal chert (two early bifaces, one drill, and one marginally retouched artifact), and one was a quartzitic sandstone early biface.

Three artifacts exhibited morphology that indicated they were completed. These included two projectile points and the artifact with extensive marginal retouch. Four early bifaces and a projectile point represented manufacturing failures. The incompleted projectile point was an arrow point. It was not possible to determine if the drill was complete or not. It is unclear whether this tool was manufactured or utilized at the site. All Pedernal tools recovered from this area exhibited successful heat treatment.

The three projectile points that were recovered included a stemmed/broadly side-notched lanceolate/palmate dart point, a corner-notched arrow point (A.D. 100-800), and a corner-notched palmate dart point (see Chapter 8).

Expedient flake tools were not recovered from this area, which supports other information that the site was a formal tool use and manufacturing area. Six additional marginally retouched artifacts were also recovered. They included three unidirectional tools and one bidirectional tool.

The lithic assemblage character in Provenience 1 represents the manufacture and use of formal tools. Both scraping and cutting tools were manufactured and used at this location.

6.8.6.3 Provenience 4

Provenience 4 represents the lithic scatter associated with the ceramic distribution adjacent to the Piedre Lumbre structure. This assemblage was examined to determine if it was different from the overall lithic scatter.

A total of 113 chipped stone artifacts was recovered from Provenience 4. These artifacts included 102 flakes and pieces of small angular debris, two bifaces, one uniface, three projectile points, and five cores.

The character of the lithic assemblage in general is similar to the rest of the surface collection. Among Pedernal chert all stages of reduction and formal tool manufacture are indicated. Thirteen percent of the assemblage exhibited cortex. The Polvadera obsidian assemblage exhibited greater evidence of primary decortication than was identified in the rest of the site. Cortex was identified on 29 percent of the assemblage, and cortical platforms occurred on four flakes.

The cores that were recovered from this area indicated varied techniques of core reduction. Five cores included two multiplatform regular cores, one multiplatform exhausted core, and two bifacial cores. There does not appear to be a correlation between technique of reduction and material type. Four cores were manufactured from Pedernal chert and one from quartzitic sandstone (multiplatform regular core). Four exhibited successful treatment, and one was unsuccessfully heat treated.

Formal tool manufacture is indicated by the number of retouched platforms. Twenty-two percent of the Pedernal platforms were retouched. Both scraping and cutting tools were manufactured or resharpened (eight unidirectional platforms and three bidirectional platforms). A similar assemblage is indicated for the Polvadera obsidian.

When platform use versus preparation is examined, formal tool resharpening is indicated. Two Pedernal retouched platforms exhibited remnant use indicating that they were removed from utilized tools.

Seven formal tools were recovered and included three projectile points, one uniface, one artifact with extensive unidirectional retouch, and two bifacial tools. With the exception of an incomplete Polvadera projectile point, all were manufactured from Pedernal chert. Two unifaces did not exhibit heat treatment.

Three artifacts (a Pedernal projectile point, a uniface, and a bifacial tool) exhibited complete morphology. All other artifacts represented manufacturing failures. The presence of the completed bifacial tool fragment in addition to the manufacturing failures supported other evidence that formal tools were utilized as well as manufactured in this area of the site.

The two projectile points included a Pedernal stemmed/broadly side-notched lanceolate point with a basal snap, a Polvadera obsidian arrow point fragment, and an undiagnostic Pedernal fragment.

There were no expedient flake tools recovered; however, five marginally retouched artifacts were identified. Four exhibited unidirectional retouch, and one exhibited bidirectional retouch. Marginally retouched artifacts were manufactured from Pedernal chert (two artifacts), Polvadera obsidian (two artifacts), and quartzitic sandstone (one artifact).

The assemblage that was recovered from Provenience 4 was similar to that found in Provenience 1 in many ways. Both formal tool manufacture and resharpening were indicated. Formal tool utilization indicating scraping and cutting activities was represented. Although expedient flake tools were not identified, marginally retouched tools were recovered. Provenience 4 exhibited less evidence than Provenience 1 of heat treatment on formal tools, although heat treatment did occur. This lack of heat treatment on formal tools may be associated with the late occupation of the site.

6.8.6.4 Provenience 2

Seven flakes and one core were recovered from the subsurface test in the southwest portion of the structure. All artifacts were manufactured from Pedernal chert, and cortical as well as noncortical debris was recovered. The presence of three flakes with bidirectionally retouched platforms suggests formal tool manufacture and bifacial core reduction. Retouched platforms occurred on two biface flakes and one core flake. A random technique of core reduction similar to that identified in other areas of the site was indicated by the presence of the regular, multiplatform core manufactured from Pedernal chert. There was no evidence of marginal retouch or expedient tool use in this provenience.

6.8.6.5 Provenience 3

Four flakes were recovered from the test pit in the center of the structure. Two were Pedernal chert, one was Polvadera obsidian, and one was quartzitic sandstone. There was no evidence of formal tool manufacture. One Pedernal flake exhibited bidirectional marginal retouch. No utilization was identified.

6.8.6.6 Summary of Lithic Assemblage and Activity Areas

The assemblage that was recovered in association with the structure (Provenience 4) was similar to the overall background assemblage with the exception of heat treatment. In both cases, reduction, tool manufacture, and tool use indicated that formal tools were manufactured, resharpened, and utilized while expedient flake tool use was not indicated. The lithic materials associated with the later occupation exhibited less heat treatment on bifacial tools and debitage than was identified in the general background lithic assemblage.

6.8.7 Ceramic, Historic, and Bone Artifacts

Ceramic items recovered from LA 27020 included 60 Valdito micaceous sherds and three Tewa Polished series sherds (Chapter 11). Two of the Tewa Polished sherds came from Level 1, Grid 111.5N/109E, while Level 1 of Grids 110N/108E and 107N/108E yielded only Valdito Micaceous sherds like those from the surface collections.

Bone items were limited to Level 1, Grid 110N/108E; they included a *Sylvilagus* spp. (cottontail) left maxilla, surface-weathered, probably associ-

ated with wood rat midden, and a roasted indeterminant large mammal shaft fragment.

Historic or probable historic items included one sanitary can lid from the 1900s and a worked, polished, and ground spherical pebble of quartzite; this pebble could represent a sling ball, a gaming piece, or a toy marble.

6.8.8 Summary

Four hundred and twenty artifacts were collected from 900 m^2 of the surface and three test pits at LA 27020. These artifacts were deposited over three general time periods. A middle to late Archaic occupation is suggested by three projectile points and many of the lithics. An A.D. 1600 to 1900 occupation is indicated by the Valdito ceramics, structure, and projectile points. A later historic component is represented by a hearth, a series of low brush fences (one of which lay within the collection unit), and a tin can. See Table 6.31 for C-14 dates. Chapters 7 and 8 discuss chronology and site occupational history, based on obsidian hydration results.

Table 6.31 LA 27020 C-14 Dates, Abiquiu Archaeology Study, ACOE, 1989.[1]

UT No.	Provenience	Uncorrected Date
5515	N110/E108, Level 1	A.D. 1900 ± 70
5516	N111.5/E109, Level 1	A.D. 1720 ± 70
5517	N107/E108, Level 1	A.D. 1690 ± 60

1 All dates are from the University of Texas - Austin Radiocarbon Laboratory.

6.8.9 Recommendations

Site boundaries to the north should be determined by mapping and collection. The brush fences should be used for dendrochronological and C-14 sampling.

6.9 LA 27041

6.9.1 Physiographic Setting

This moderate density lithic scatter occurs on a bend at an elevation of 6280 feet. The area is located on the northern edge of a low, east-west trending ridge. The northern edge of the ridge is a low escarpment (5 m) carved by an unnamed, east-west trending drainage. The drainage flows west approximately one-half mile to its junction with the Chama River. Capping deposits on the ridge consist of grass-covered colluvial sands, while the deflated northern edge and escarpment of the ridge are covered with dense

quartzite cobbles. Artifacts are located on sand and gravel deposits paralleling the drainage. Most artifacts, however, occur on and in the gravel deposits on or adjacent to the drainage escarpment.

6.9.2 Previous Work

This site was characterized in the original survey descriptions as a 60 x 40 m lithic scatter containing approximately 200 artifacts. Two distinct artifact concentrations located 20 m apart were reportedly mapped. A hearth feature and the survey datum were reportedly located in the easternmost concentration (Reed et al. 1982:118).

6.9.3 Field Methods

MAI's reexamination of the area revealed only one discrete lithic concentration. This concentration measures approximately 20 x 20 m and is located near the center of a larger, much more diffuse lithic scatter. This larger scatter extends approximately 20 m to the south and 30 m to the east and west of the concentration. No boundaries were discernible for the northern portion of the scatter; it extends down the steep, cobble-strewn slope to below water line. The original site datum was located within this artifact concentration which must be taken to correspond with the earlier survey's easternmost concentration. No ash or fire-cracked rock suggestive of a hearth feature was present.

6.9.4 Collection Units

Surface collection consisted of one 30 x 30 m unit (Figure 6.42). This unit was located to include most of the high density surface concentration as well as less dense, probably undeflated areas to the south and east of the concentration. This collection unit did not include the extreme northern portion of the concentration. Owing to the steep slope, the depositional and locational integrity of artifacts in this latter area was suspect. Approximately 1,085 lithic artifacts were collected from the surface of LA 27041. Most materials were from 116 adjacent 1-m^2 units located in the northwest corner of the collection grid. Within this concentration, the surface density reached a maximum of 31 flakes/m^2; the center of the concentration exhibited the highest frequencies. Included in this count were six bifaces and two projectile points. The projectile points were manufactured from obsidian and resembled Late Archaic En Medio and San Pedro types.

6.9.5 Subsurface Samples and Stratigraphy

Two 1 x 1 m test units were excavated. All materials were screened through 1/4-inch mesh. Samples are listed in Table 6.32. Test Unit 1 (124N/114E) was located within the major surface concentration. This unit was also placed adjacent to and slightly upslope from the densest grids within the artifact concentration on the assumption that some downslope movement of artifacts had occurred in the course of deflation. This unit was excavated in arbitrary 10-cm levels to a depth of 40 cm.

Figure 6.42 LA 27041, Abiquiu Archaeological Study, ACOE, 1989.

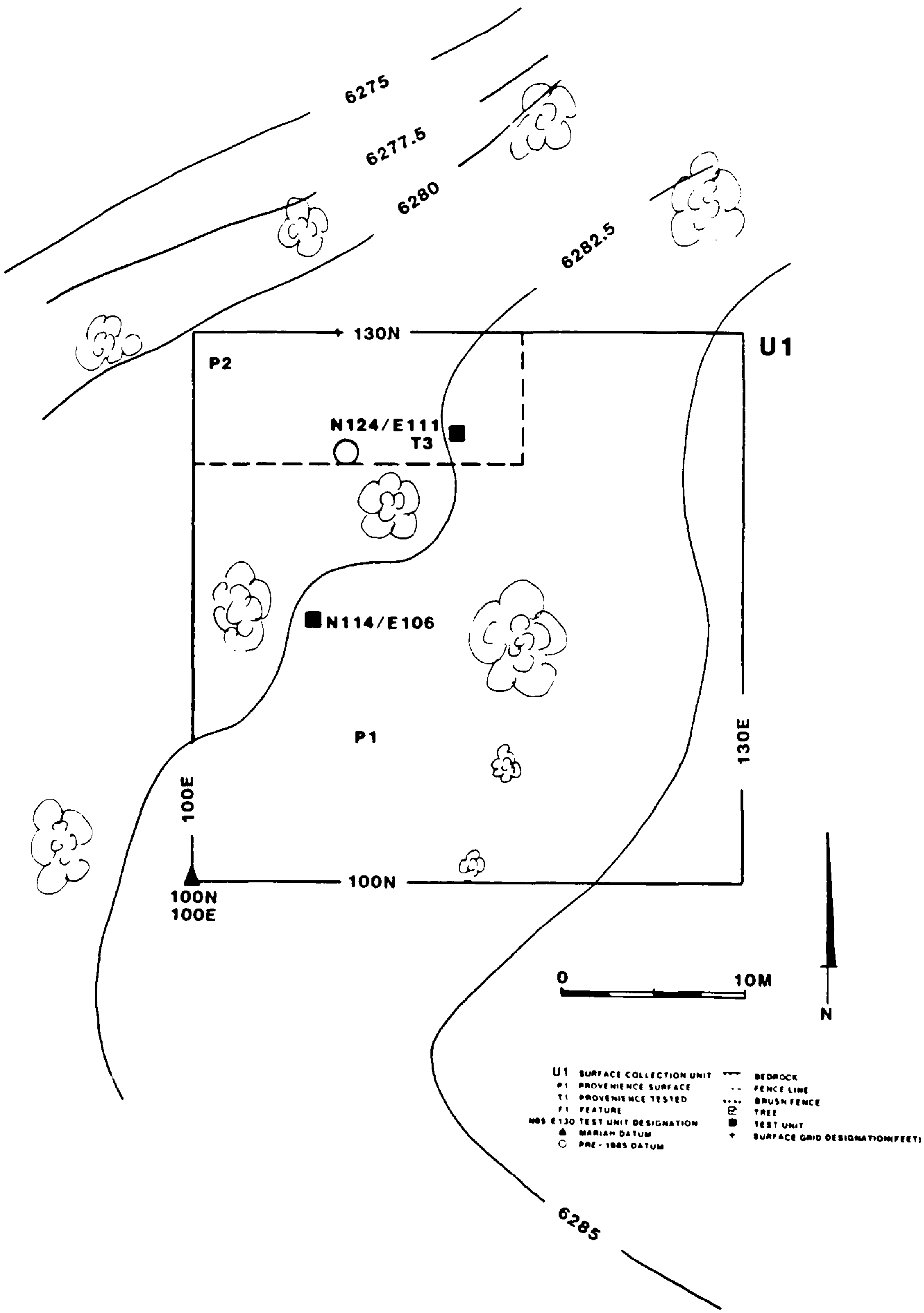


Table 6.32 LA 27041 Samples, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
N114/E106, Level 2	1	1	--
N124/E114, Level 1	1	1	--

Test unit N124/114E yielded a total of 54 subsurface artifacts. These were located in the top three levels of the unit and consist of one core, one mano, and 52 flakes. The subsurface matrix in the upper level of this unit consisted of a silty loam intermixed with 4-6 cm long cobbles (Figure 6.43). Levels 2 and 3 contain a similar matrix except the size of the cobbles increased to 18 cm in length. The fourth level contained no artifacts, and the matrix contained a higher clay content and fewer cobbles.

Test unit N114/E106 contained no subsurface artifacts. The matrix in all levels consisted of a clayey sand intermixed with large (10 x 10 x 6 cm) to pea-sized gravels. This unit was excavated to a level which contained dense gravels and caliche intermixed with a basal shale. The absence of cultural materials in this unit suggests that the artifactual materials do not extend upslope from the major surface concentration, contrary to the initial expectation of buried cultural deposits in the undeflated areas.

This unit was located upslope of the major concentration in sandy deposits to determine if buried cultural materials remained in place. This unit was excavated in arbitrary 10-cm levels to a depth of 40 cm (Figure 6.44).

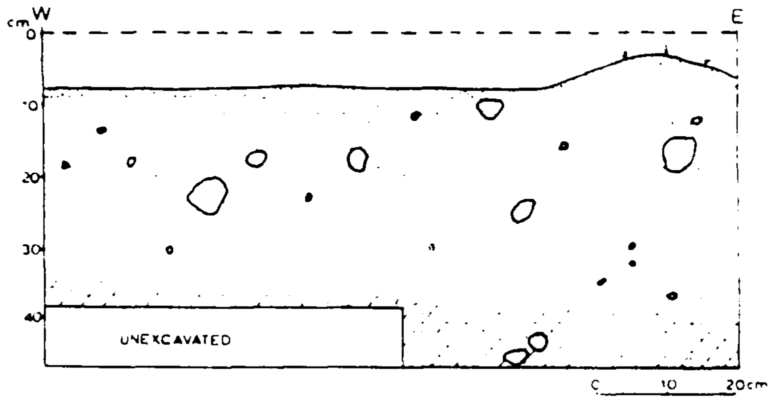
6.9.6 Rough Sort and Detailed Lithic Analysis

LA 27041 represents a discrete lithic scatter located within a diffuse scatter. A 30 x 30 m surface collection unit (Unit 1) was placed over the distribution. An examination of artifact distribution maps isolated two proveniences in Unit 1. Provenience 2 includes a high density concentration located in the northwest corner of the unit (123-129N/100-117E). Provenience 1 includes the low density scatter in the rest of the unit. Two subsurface grids were excavated. Grid 124N/114E (Provenience 3) was placed in the surface concentration (Provenience 2) to determine if in situ subsurface deposits existed. The second subsurface grid (114N/106E; Provenience 4) exhibited no artifactual materials.

6.9.6.1 Introduction

A detailed sample was examined and selected on the basis of surface field maps. A total of 231 artifacts was included in this sample. Data derived from the rough sort attributes are discussed for all proveniences. Information gained from the detailed sample are integrated when applicable.

Figure 6.43 LA 27041, N124/E114, North Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

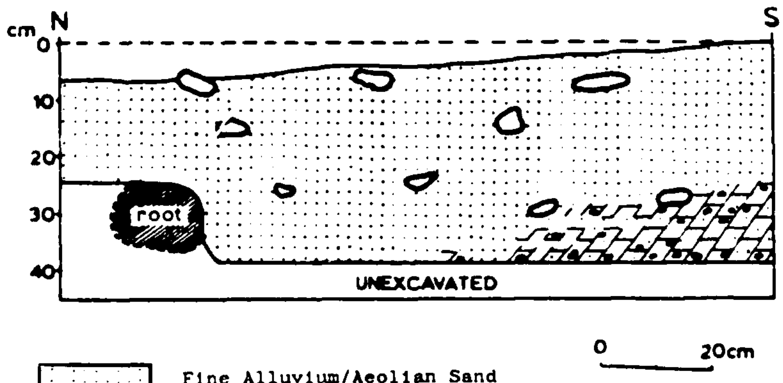


Loose Surface Sand

Dark Brown Sandy Loam with Many Large and Small Stones
5YR 5/6

Light Brown Sandy Clay with Fewer Rocks
5YR 3/6

Figure 6.44 LA 27041, N114/E106, East Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



Fine Alluvium/Aeolian Sand
5YR 3/4

Stream Pebbles

Clayey, Calichified Sand and
Gravel

A total of 1,156 chipped stone artifacts was recovered from the site (Table 6.33). Artifacts included 1,132 flakes and pieces of small angular debris, 17 bifaces, two unifaces, three projectile points, and two cores. Ceramic, ground stone, faunal, and historic artifacts were not encountered.

An examination of heat treatment on the site indicates that Pedernal chert was the only material treated. Eighty-seven percent of the Pedernal assemblage (710 artifacts) exhibited heat treatment. Of these, 75 percent (530) were successfully treated, and 25 percent (180) exhibited unsuccessful treatment.

Table 6.34 describes heat treatment by artifact type. In many assemblages the percentages of heat treated materials among bifaces and biface debitage are much higher than core debitage. These percentages usually range from 80 percent to 100 percent. Within this assemblage similar percentages of heat treatment occur among biface manufacture and core reduction debitage. Both classes of debitage exhibit 59 percent heat treatment and 40 percent nonheat treatment. Actual bifaces exhibit a slightly higher percentage of heat treatment (74 percent).

6.9.6.2 Unit 1, Provenience 2

Provenience 2 represents the high density lithic concentration located in the northwest corner of Unit 1. A total of 976 chipped stone artifacts was recovered. Artifacts included 957 flakes and pieces of small angular debris, three points, 14 bifaces, and two unifaces. The assemblage was composed primarily of Pedernal chert (72 percent, 704 artifacts) and Polvadera obsidian (23 percent, 224 artifacts). A fossiliferous cream chert made up two percent (18 artifacts) of the assemblage. The remaining three percent represented 10 material classes and included 30 artifacts. Seven of the flakes were manufactured from a vitrophyre basalt with a closest known source in the San Antonio Mountains. The remaining materials were probably of local origin.

The formal tools that were recovered from Provenience 2 provide strong evidence that formal tools were used as well as manufactured at the site; the assemblage included two blanks, seven early bifaces, one late biface, five bifacial tools, three projectile points, and three unifaces (Appendix F). Eight artifacts were manufactured from Polvadera obsidian, 10 from Pedernal chert, one from quartzitic sandstone, and one from basalt. The presence of a quartzitic sandstone uniface supports the minimal evidence provided by the debitage that formal tool manufacture or resharpening occurred.

The provenience exhibited a large number of completed bifacial tools and points (five tools and one point). These tools included four Pedernal bifacial tools, one basalt bifacial tool, and one Polvadera obsidian projectile point fragment. The remaining artifacts represented manufacturing failures that were discarded prior to completion. These incompleted artifacts indicated that Pedernal, basalt, and Polvadera formal tool manufacture occurred at the site.

The formal tool assemblage indicates that bifacial tool use occurred in addition to bifacial and unifacial tool manufacture. One projectile point was

Table 6.33 LA 27041 Artifact Type to Material Type Frequencies (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

Material Type	Artifact Type: Biface	Core	Flake	Projectile Point	Small Angular Debris	Uniface	Total
Miscellaneous	--(--)	--(--)	34(97)	1(4)	--(--)	--(--)	35
Fossiliferous Tan Chert	--(--)	--(--)	18(100)	--(--)	--(--)	--(--)	18
Green Chert	--(--)	--(--)	2(100)	--(--)	--(--)	--(--)	2
Morrison Chert	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	1
Moss Jasper	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	1
Nacimiento Chert	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	1
Pedernal Chert	12(1)	1(<1)	760(93)	--(--)	44(5)	--(--)	817
Polvadera Obsidian	4(2)	--(--)	243(94)	2(1)	9(3)	1(<1)	259
Quartzitic Sandstone	--(--)	1(11)	7(78)	--(--)	--(--)	1(11)	9
Quartzite	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	1
Silicified Wood	--(--)	--(--)	2(100)	--(--)	--(--)	--(--)	2
Vitrophyre	1(10)	--(--)	9(90)	--(--)	--(--)	--(--)	10
Total	17(1)	2(<1)	1,079(93)	3(<1)	53(5)	2(<1)	1,156

Table 6.34 LA 27041 Heat Treatment for Chert to Artifact Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total # Treated	Successful	Unsuccessful	Successful Core	Successful Flake	Total # Successful	Total
Biface Flake	5	87	81	4	2	--	83	92
Biface	--	14	11	2	--	1	12	14
Bifacial core	--	1	--	--	1	--	1	1
Core Flake	39	227	149	75	3	--	152	266
Pressure Flake	1	8	--	--	8	--	8	9
Small Angular Debris	6	38	17	21	--	--	17	44
Unidentified Flake	56	328	245	78	4	1	250	384
Unifacially Retouched Flake	--	7	4	--	3	--	7	7
Total	107	710	507	180	21	2	530	817

identified as a side-notched arrow point. It exhibited incomplete morphology and was manufactured from Polvadera obsidian.

Expedient tool utilization was also represented in this provenience. Two flake tools exhibited unidirectional wear indicative of scraping activities. One was manufactured from Pedernal chert, the other from Nacimiento chert. Both unidirectional and bidirectional marginal retouch was recorded on nine flakes (four bidirectional and five unidirectional). A single obsidian flake exhibited dorsal battering which is characteristic of ground stone sharpening. Provenience 2 was obsidian hydration dated to the Early Developmental Period and En Medio Phase/Basketmaker II times.

6.9.6.3 Unit 1, Provenience 1

Provenience 1 included the low density lithic scatter in Unit 1 excluding the high density Provenience 2. A total of 127 lithic artifacts was recovered. These included 123 flakes and pieces of small angular debris, three bifaces, and one core. Pedernal chert made up 65 percent of the assemblage (82 artifacts). Polvadera obsidian totaled 13 percent (17 artifacts); the remaining 28 artifacts represented four material groups. All materials were locally available with the exception of vitrophyre basalt, which occurs in the San Antonio Mountains.

Four formal tools were recovered from this area. They included two early bifaces, one uniface, and one artifact with extensive unidirectional retouch. With the exception of the retouched artifact, all were manufacturing failures. These data support other information that the assemblage represented a manufacturing location more than a tool utilization area. No expedient tools were recovered from this location. No dates are available for this provenience.

6.9.6.4 Unit 1, Provenience 3

Provenience 3 is a subsurface test that was placed in the lithic concentration (Provenience 2) to determine if in situ, subsurface deposits remained. A total of 53 chipped stone artifacts was recovered. They included 52 flakes and one core. The material composition was similar to that identified on the surface. Pedernal chert comprised 58 percent (31 artifacts) of the assemblage while Polvadera obsidian made up 34 percent (18 artifacts).

The overall assemblage character was similar to that identified for surface materials. No cortical debris was recovered. Formal tool manufacture was indicated by retouched platforms of Pedernal chert and Polvadera obsidian. Retouched platforms were identified on 26 percent of Pedernal flakes with platforms and 46 percent of Polvadera flakes with platforms.

The six obsidian dates for Provenience 3 include three dates from En Medio Phase/Basketmaker II times, one date from the Late Developmental Period, and two dates from the Rio Grande Classic Period.

6.9.6.5 Lithic Summary and Activity Areas

LA 27041 represented a manufacturing and use activity area within a general scatter of manufacturing debris. The concentration (Provenience 2) exhibited clear evidence that a number of use activities was carried out in this area. Activities were performed with formal and expedient tools and represented both cutting and scraping. This concentration exhibited the greatest number of completed formal tools in the study area, suggesting a strong emphasis on tool use.

6.9.7 Summary

LA 27041 consists of one discrete artifact concentration. A 900-m^2 collection unit contained 1,145 lithic artifacts, most of which lay in the northwest portion of the unit. Two test pits were excavated within and upslope of the artifact concentration. Results of these excavation units suggest that subsurface artifacts are present within but do not extend a great distance outside of the surface concentration. Details on chronology and site occupational history are given in Chapter 7.

6.10 LA 27042

6.10.1 Physiographic Setting

This large lithic scatter is located along and below the eastern edge of an isolated mesa at an elevation of 6260 to 6270 feet. This west sloping mesa has been formed by erosional processes which truncated the southern escarpment of Comanche Canyon and formed a low saddle between this mesa and a mesa directly to the east. Comanche Canyon lies directly north of the site area. Deposits in the saddle area appear to consist of basal shales overlain by sandstone fragments and gravels. The eastern edge of the escarpment rises 3 to 4 m above the saddle and is covered with large and medium-sized quartzite gravels. Deposits approximately 2 to 3 m away from this edge are also characterized as gravels, but upslope to the west the deposits are stable, grass-covered sands.

6.10.2 Previous Work

The original survey reported a large lithic site containing thousands of artifacts in an approximately 6,000-m^2 area. A revisitation in 1982 (Reed et al. 1982:91-92) also reported a large site but estimated the artifact count to be in the hundreds rather than thousands. Examination of the site during this project extended original site boundaries by noting that artifacts were present on the saddle below the eastern escarpment and along the southern mesa rim. One small, discrete obsidian scatter was present near the top of the mesa. MAI's work suggested that site artifacts number in the low thousands. No obvious features were recognized by any of the visitations. The CCP study nominated a new site (LA 47941) which probably represents a northern extension of LA 27042; this included a Hispanic road noted but not recorded in the present survey (Lord and Cella 1986).

6.10.3 Collection Units

In the present study 422 m^2 were surface collected in five units. Collection Unit 1 (Figure 6.45) was placed on the lower saddle and consisted of an 8 x 10 m block situated over a diffuse lithic scatter typical of this area of this site. This was located in and on the southern slope of the saddle. Adjoining this was a 2 x 10 m, north-south transect which crosscut the northern slope of the saddle at Abiquiu Lake's margin. Artifact distributions existing downslope to the south were inundated, if present, and hence could not be monitored. Imminent inundation promoted selection of these units.

Collection Unit 1 yielded approximately 101 lithic artifacts. A rather uniform surface distribution is suggested in this area of the site, and the surface density reached a maximum of 11 items/m^2.

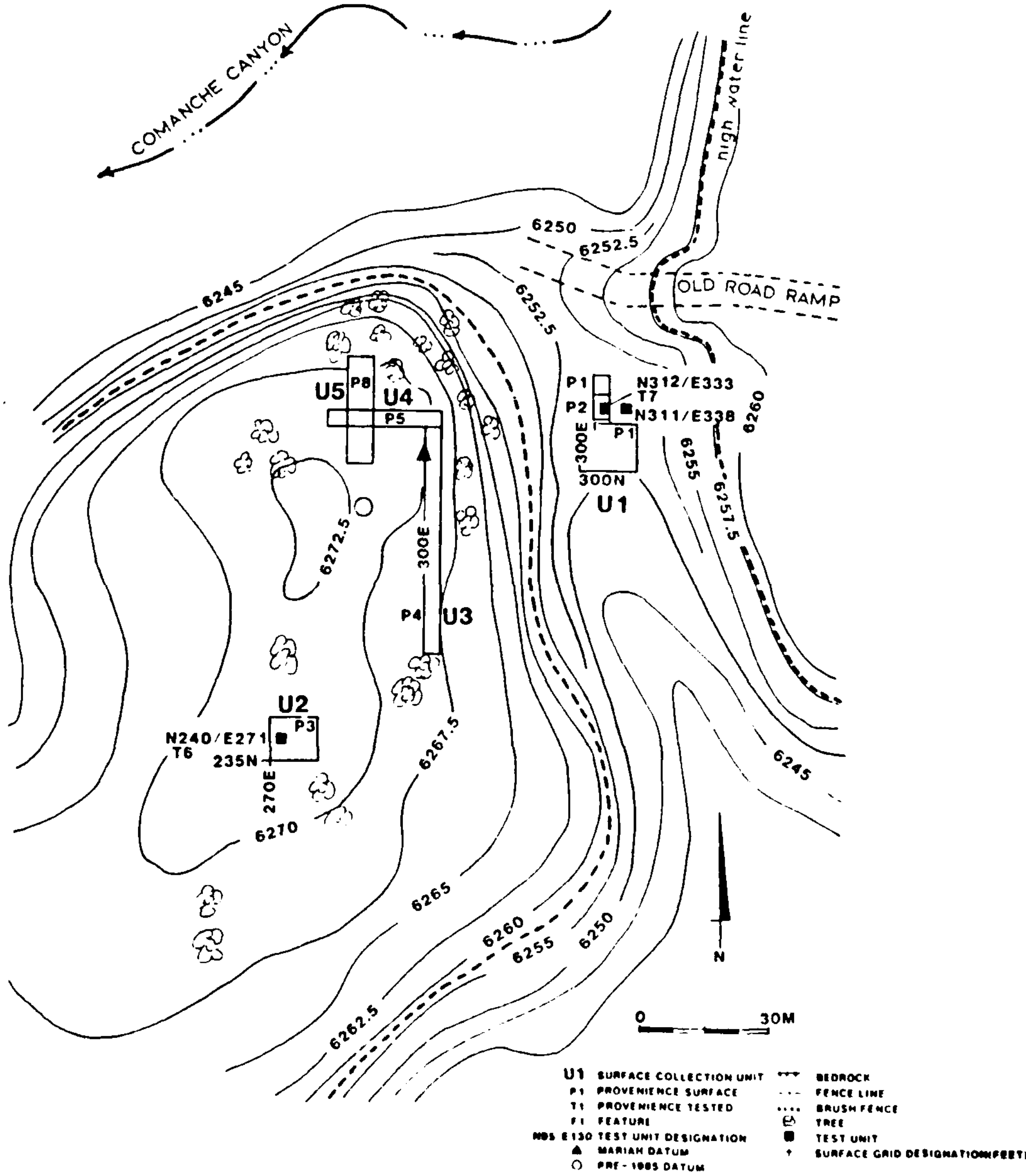
Collection Unit 2 was located near the top of the stable, sand-covered mesa in an isolated scatter composed almost entirely of obsidian flakes. This unit consisted of a 10 x 10 m block, chosen to evaluate the only small and isolated scatter encountered on the site. The collection unit recovered 111 lithic artifacts. These consisted of lithic debitage and did not include any retouched tools. Eleven items/m^2 were the maximum surface density in this area.

Collection Unit 3 consisted of a 50 x 2 m, north-south transect which was located to sample the major surface scatter. It paralleled the eastern escarpment. The maximum density in Unit 3 was nine items/m^2. The surface distribution in this unit, which paralleled the major surface scatter at this site, revealed a generally low density scatter. The southern end of the transect, however, did appear to crosscut a concentration around 267N to 278N. One of the Sudden Side-Notched style obsidian dart points was located at this end of the collection unit.

Collection Unit 4 was a 2 x 25 m, east-west transect which crosscut the east slope of the mesa top. This collection unit abutted the northern end of and ran perpendicular to Unit 3. It was chosen to sample along a presumed deflational gradient. Collection Unit 4 suggested a somewhat higher density scatter than did Unit 3. One hundred and forty items were present in this 50 m^2 transect; the maximum surface density reached 12 items/m^2.

Collection Unit 5 was a 20 x 4 m, north-south transect which overlapped 8 m^2 of the western end of Unit 4. Consequently, this unit represented a 72-m^2 collection area. The southern end of this collection unit was on level sand deposits while the northern end was on the north sloping side of the mesa in gravelly deposits. It was chosen to sample an area thought to exhibit material choices (i.e., chalcedony) atypical of the site as a whole. Collection Unit 5 recovered only 20 items in 72 m^2, and the maximum density was two lithics/m^2.

Figure 6.45 LA 27042, Abiquiu Archaeological Study, ACOE, 1989.



6.10.4 Subsurface Samples and Stratigraphy

Three test pits were excavated. One unit (312N/333E) was located in a high density concentration of surface artifacts, a second (311N/338E) was placed to search for a buried thermal feature, and a third (240N/271E) was located to evaluate deposition in an apparently undeflated surface obsidian concentration. Samples are listed in Table 6.35. Two of these were located in the lower saddle area and were screened through 1/4-inch mesh. Unit 312N/333E was located within the Unit 1 surface collection maximum concentration; it was excavated to a maximum 25-cm depth. An additional unit (311N/338E) was located just northeast of the collection block. This test unit was located slightly upslope of several burned or potlidded lithic artifacts and was chosen to evaluate the possibility of subsurface thermal features. This uncollected area was in a diffuse scatter similar to the collected area; it was excavated to 15-cm depth.

Table 6.35 LA 27042 Samples, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
N240/E271, Level 2	1	1	--
N312/E333, Level 2	1	1	--

Seven subsurface artifacts were present in unit 312N/333E, and the majority was located in the second 10-cm level. The matrix in the unit consisted of a sandy clay which contained small pieces of friable sandstone. This unit was excavated to a maximum depth of 25 cm, where sandstone bedrock was encountered (Figure 6.46).

Test pit 311N/338E was excavated adjacent to collection Unit 1 and contained no subsurface artifacts. The subsurface matrix was a sandy clay with sandstone fragments, and the unit reached bedrock sandstone 15 cm below the modern ground surface (Figure 6.47).

One excavation unit (240N/271E) was located in the obsidian surface scatter (Unit 2) near the top of the mesa and was screened through 1/8-inch mesh. The stable sand deposits and the discrete spatial occurrence of this scatter suggested the presence of subsurface cultural materials. This unit was excavated to a 40-cm depth to test for subsurface deposits in this apparently undeflated but surficial scatter.

Test unit 240N/271E was located within surface Unit 2 and yielded 35 subsurface artifacts. The majority of these was located in the upper 10 cm level and consisted of very small flakes and flake fragments which would not have been recovered if 1/8-inch screening had not been employed. As with the surface materials, these were mostly obsidian. The subsurface matrix consisted of a sandy loam which contained small caliche nodules (Figure 6.48).

Figure 6.46 LA 27042, N312/E333, North Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

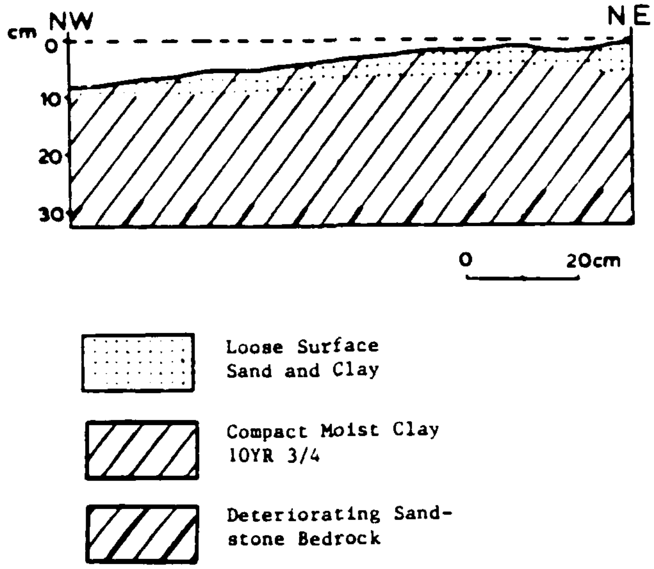
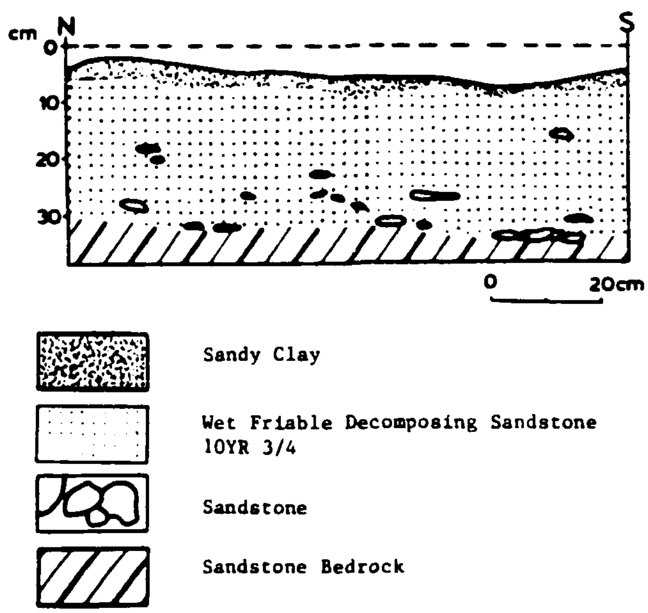
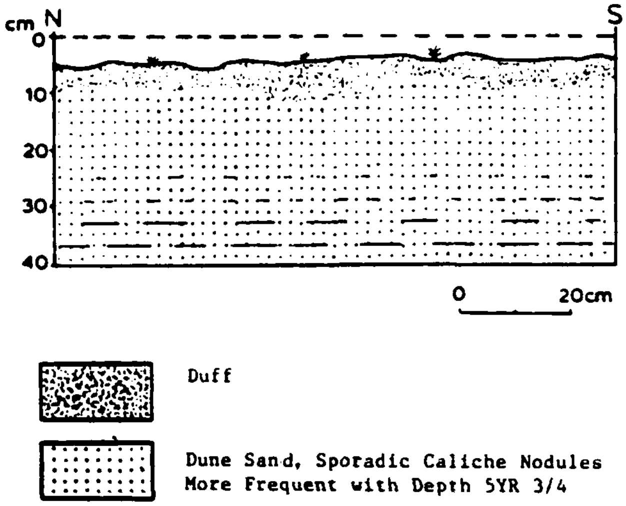


Figure 6.47 LA 27042, N311/E338, East Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



The caliche appeared to increase in size and quantity with depth, and the unit was closed when the fourth 10-cm level proved sterile.

Figure 6.48 LA 27042, N240/E271, East Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



6.10.5 Rough Sort and Detailed Lithic Analysis

LA 27042 was an extensive moderate density lithic scatter that represented multiple occupations of the area. A total of 422 m^2 was surface collected in five collection units. Unit 1 was an 8 x 10 m, east-west transect with a 2 x 8 m northerly extension, located over a general lithic scatter. Surface distribution maps identified a moderately dense concentration in grids 308-318N/332-333E (Provenience 2). The remainder of Unit 1 was described as Provenience 1. Unit 2 (Provenience 3) was a 10 x 10 m surface collection unit that was placed over an isolated obsidian scatter. Unit 4 (Provenience 5) was a 2 x 25 m, east-west transect located to sample a deflated scatter. Unit 5 (Provenience 8) was 4 x 20 m, north-south transect located to sample a distribution of chalcedony debris. Unit 9 (Provenience 9) represented artifacts that were collected outside of the surface collection units.

Three subsurface test pits were excavated. Provenience 6 was a subsurface test in Provenience 3 placed at the edge of the obsidian concentration (240N/271E). Provenience 7 represented a subsurface test pit placed in Provenience 2 to determine if in situ deposits were present (312N/333E). The third test pit (311N/338E) yielded no subsurface materials.

A detailed analysis was conducted on the entire assemblage recovered from Unit 2 (Provenience 3). Proveniences are described in order of units, and a

discussion of the detailed sample is included in the Provenience 3 description. Detailed samples were not chosen from any other area of the site.

A total of 477 chipped stone artifacts was recovered from the site (Table 6.36). These artifacts included 462 flakes and pieces of small angular debris, 10 bifaces, four projectile points, and one piece of large angular debris. No ground stone, ceramics, or faunal or historic artifacts were recovered.

Table 6.36 LA 27042 Artifact Type to Material Type Frequencies (Row Percentage in Parentheses) Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type					
Material Type	Biface	Flakes	Large Angular Debris	Projectile Point	Small Angular Debris	Total
Jemez Obsidian	--(--)	38(100)	--(--)	--(--)	--(--)	38
Miscellaneous Chert	--(--)	3(100)	--(--)	--(--)	--(--)	3
Pedernal Chert	3(2)	158(91)	1(1)	1(1)	10(5)	173
Polvadera Obsidian	7(3)	231(92)	--(--)	3(1)	12(5)	253
Quartzitic Sandstone	--(--)	5(100)	--(--)	--(--)	--(--)	5
Quartzite	--(--)	1(100)	--(--)	--(--)	--(--)	1
Rhyolite	--(--)	1(100)	--(--)	--(--)	--(--)	1
Silicified Wood	--(--)	1(100)	--(--)	--(--)	--(--)	1
Vitrophyre	--(--)	2(100)	--(--)	--(--)	--(--)	2
Total	10(2)	440(92)	1(<1)	4(1)	22(5)	477

Most artifacts recovered from the site were manufactured from Polvadera obsidian (53 percent, 252 artifacts) and Pedernal chert (36 percent, 173 artifacts). The high percentage of Polvadera obsidian is not typical of sites in the study area. The Jemez obsidian frequency in the assemblage was also high (eight percent, 38 artifacts). The remaining 13 artifacts were manufactured from six material classes. With the exception of two flakes that were manufactured from vitrophyre basalt, all debitage material types occur locally in gravels. The nearest known vitrophyre basalt source is San Antonio Peak.

Pedernal chert was the only material that exhibited evidence of heat treatment. Eighty-three percent of the assemblage was treated (143 artifacts). Only 17 percent (25) of the heat treated artifacts were unsuccessfully treated.

Table 6.37 describes the types of Pedernal chert artifacts that exhibited heat treatment. Ninety-six percent of the biface flakes (27 flakes) and 100 percent of the bifaces (three bifaces) exhibited heat treatment. Both uniface

flakes were heat treated. Sixty-three percent of the core flakes were heat treated.

Table 6.37 LA 27042 Heat Treatment for Chert to Artifact Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total / Treated	Successful	Unsuccessful	Successful Flake	Total / Successful	Total
Miscellaneous	--	1	1	--	--	1	1
Biface Flake	1	27	27	--	--	27	28
Biface	--	3	1	2	--	1	3
Core Flake	19	33	19	13	1	20	52
Large Angular Debris	--	1	1	--	--	1	1
Projectile Point	--	1	1	--	--	1	1
Small Angular Debris	2	8	3	5	--	3	10
Unidentified Flake	8	67	62	5	--	62	75
Unifacially Retouched Flake	--	2	2	--	--	2	2
Total	30	143	118	25	1	118	173

6.10.5.1 Unit 1, Provenience 2

Provenience 2 was a lithic concentration comprised primarily of Pedernal chert that was located in the center of Unit 1. A total of 55 chipped artifacts was recovered from a 2 x 5 m area and included 53 flakes and pieces of small angular debris, one biface, and one projectile point.

Ninety-four percent of the artifacts were comprised of Pedernal chert. The remainder included two Polvadera flakes and a Jemez obsidian flake.

A single Pedernal flake with unidirectional use wear and a unidirectionally marginally retouched flake indicated that scraping activities were carried out.

One biface flake was retrieved providing additional evidence that bifacial tool manufacturing occurred. The biface blank fragment was manufactured from successfully treated Pedernal chert. One projectile point fragment was recovered. It was manufactured from Polvadera obsidian and was described as a side-notched palmate dart point.

The assemblage that was recovered from Provenience 2 represents a formal tool manufacturing location, as well as scraping activity area. The lack of cortical debris indicates that decortication occurred in another location.

6.10.5.2 Unit 1, Provenience 1

Provenience 1 represents the low density lithic scatter excluding Provenience 2 in Unit 1. A total of 45 chipped stone artifacts was recovered from this area. Artifacts included 44 flakes and pieces of small angular debris, and one biface. Ninety-six percent of the assemblage was composed of Pedernal chert (43 artifacts). The remaining two flakes were manufactured from Jemez obsidian (one flake) and Polvadera obsidian (one flake).

The Pedernal assemblage recovered from this area is similar to that identified for Provenience 2. In general, evidence of primary decortication is limited, while secondary reduction and formal tool manufacture are clearly represented.

The assemblage recovered from Provenience 1 is similar to the concentration collected from the central portion of Unit 1 (Provenience 2). The assemblage indicates that formal tool manufacturing, resharpening, and use occurred, as well as expedient tool use. The limited evidence of primary reduction indicates that decortication occurred at another location.

6.10.5.3 Unit 2, Provenience 3

Unit 2 is a diffuse, discrete obsidian concentration. A total of 98 chipped stone artifacts was recovered from this unit. These included 93 flakes and five pieces of small angular debris. Ninety-nine percent of the assemblage was comprised of Polvadara obsidian (97 artifacts). A single flake was manufactured from Pedernal chert.

The overall assemblage indicated secondary reduction and tertiary formal tool manufacture. Limited evidence of primary reduction was identified.

The formal tool was an artifact with extensive bidirectional retouch (Appendix F). The marginally retouched artifact was manufactured from Polvadera obsidian, and was a manufacturing failure.

Provenience 3 (Unit 2) represented a formal tool manufacturing, resharpening, and use location, as well as an area where expedient tool use occurred. Again, limited evidence of decortication was represented.

6.10.5.4 Unit 3, Provenience 4

Provenience 4 included all the surface materials from Unit 3. A total of 72 chipped stone artifacts was recovered from Provenience 4. These artifacts included 68 flakes and pieces of small angular debris, two bifaces, one projectile point, and one piece of large angular debris.

The provenience exhibited a much higher percentage of Polvadera obsidian than other sites. Fifty-six percent (40 artifacts) belonged to this material class. This class was followed in frequency by Pedernal chert which represented 33 percent of the assemblage (24 artifacts). The remaining 11 percent of the assemblage was represented by three lo[illegible]terial classes: Jemez obsidian (six artifacts), miscellaneous chert (one [illegible]ct), and silicified wood (one artifact).

The point was manufactured from Polvadera obsidian and, judging by morphology, was completed. Two incompleted early bifaces provide additional evidence of formal tool manufacture. Both were manufactured from Polvadera obsidian and were manufacturing failures.

Although no evidence of formal tool utilization was identified in this provenience, the presence of two Polvadera flakes with unidirectional use wear and a bidirectional marginally retouched Polvadera flake indicates that scraping and cutting activities occurred in the area.

6.10.5.5 Unit 4, Provenience 5

Provenience 5 represents the surface collection from Unit 4. The chipped stone artifacts recovered from this provenience totaled 138. These included 135 flakes and pieces of small angular debris and three bifaces.

This provenience exhibited the greatest diversity in material selection across the site. Polvadera obsidian (44 percent, 61 artifacts) was followed in frequency by Pedernal chert (29 percent, 37 artifacts). These material categories were followed by a high percentage of Jemez obsidian (22 percent, 30 artifacts). Jemez obsidian is not typically frequent on sites in the study area. The remaining five material groups were represented by 10 artifacts. Two flakes were manufactured from vitrophyre basalt with the closest sources at San Antonio Peak. All other materials are locally available.

No evidence of expedient tool use was identified in this assemblage. This assemblage appears to represent a formal tool manufacturing and use location.

6.10.5.6 Provenience 6

The subsurface test placed near the obsidian concentration (Provenience 3) identified 33 Polvadera obsidian flakes.

The overall lack of cortical debris suggests that decortication occurred in another location. The lack of evidence of utilization in conjunction with clear evidence of bifacial tool manufacture indicates that this provenience represents a formal tool manufacturing location.

6.10.5.7 Unit 5, Provenience 8

Provenience 8 represents the surface lithic scatter collected from Unit 5. Nineteen flakes and one piece of small angular debris were recovered from this area. Fifteen of these artifacts were manufactured from Polvadera obsidian and five from Pedernal chert. Low frequencies prevent an extensive examination of reduction; however, the Polvadera obsidian assemblage exhibits little cortex and one retouched platform suggesting that formal tool manufacture occurred and decortication occurred at another location.

6.10.5.8 Provenience 7

Provenience 7 represents the subsurface test placed in Provenience 2. A total of nine flakes was recovered from this test. All were manufactured from Pedernal chert. A single retouched platform exhibited evidence of preparation indicating that formal tool manufacture is represented. There was no evidence of resharpening or tool use in this provenience.

6.10.5.9 Provenience 9

This provenience included artifacts that were collected outside the collection units and miscoded artifacts. The miscoded artifacts included two flakes. Five formal tools were recovered outside the collection unit. They included two projectile points, two early bifaces, and one bifacial blank. The majority of these artifacts was manufactured from Polvadera obsidian. Only the completed projectile point was manufactured from Pedernal chert. This point fragment was the basal portion of a successfully treated PaleoIndian or early Archaic point. The other projectile point fragment was a side-notched palmate dart manufactured from Polvadera obsidian. The lack of completed bifacial artifacts supports other data that the site was used for formal tool manufacturing.

6.10.5.10 Lithic Summary and Site Activities

The lithic assemblage recovered from LA 27042 exhibited the greatest diversity in material selection among sites in the study area. High frequency material categories were represented for all proveniences. LA 27042 exhibited higher percentages of Polvadera obsidian than Pedernal chert. Additionally, Jemez obsidian contributed heavily to the lithic assemblage that was recovered from Provenience 5.

The reduction indicated by the assemblages generally indicates minimal evidence of primary decortication. Clear evidence of formal tool manufacture was identified in most assemblages. Formal and expedient tool utilization occurred in different areas across the site. The clear emphasis on the reduction of Polvadera obsidian in most assemblages may indicate that these reduction episodes occurred at the same time. The overall material variability is very different from other sites.

6.10.6 Summary

Approximately 434 lithic artifacts were collected from the surface of this site. These included one projectile point inside and two projectile points located outside the surface collection units. One of the points was located on the lower saddle area and represented a late PaleoIndian point type. The other points were located on the mesa top and exhibited a form similar to the Sudden Side-Notched type. Both points located outside the collection units occurred in isolated contexts. One was described and drawn by the Nickens survey team. Refer to Chapters 7 and 8 for more details on chronology.

A 422-m^2 area was surface collected, and three subsurface test pits were excavated at LA 27042. The surface density represented by the five collection units suggested that the total artifacts number in the low thousands; a multiple component occupation was suggested by the large size of the site. Few subsurface artifacts were present, and no definite cultural horizons or features were located by the subsurface testing.

6.10.7 Recommendations

Site boundaries to the south and west should be determined by mapping and collection during low water periods. Isolated scatters in the stable dune mesa cap should be tested. The historical road ramp should be recorded.

6.11 LA 27002

6.11.1 Physiographic Setting

This small lithic scatter is located on the north edge of a broad, relatively flat mesa northwest of Arroyo del Chamiso, at an elevation of 6275 feet. Although the mesa generally declines to the west, in the site area the topography dips to the north toward an incised and unnamed drainage. The drainage flows west until it joins the Chama River approximately 250 m to the west. The majority of the site is located along the gently to sharply sloping north mesa edge. Deposits upslope and south of the area are stabilized sands and loams, while the site is situated on sandstones overlain with gravels and thin sands.

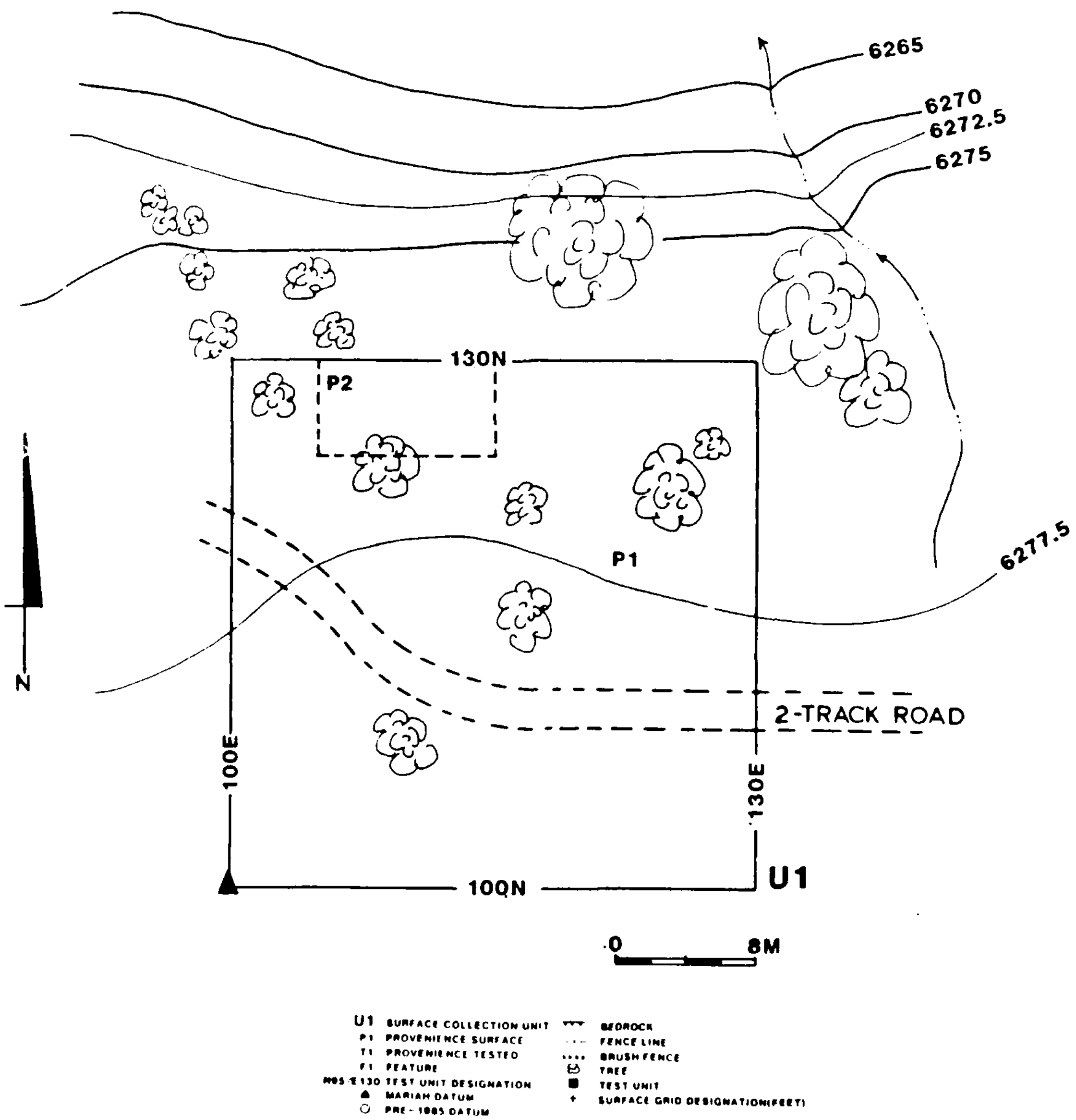
6.11.2 Previous Work

This site was originally reported (Schaafsma 1976:54) as a 20 x 50 m lithic scatter containing artifacts numbering in the low hundreds. The Nickens and Associates survey was unable to relocate the site (Reed et al. 1982:118). One hearth area was reported by Reed but not described. Reexamination by MAI crews suggested a discrete lithic scatter located in an approximately 20 x 15 m area. Additional diffuse artifacts were located both in the upslope sands south of the area and to the east and west along the eroded rim of the mesa. No ash, fire-cracked rock, or burned sandstone was present to suggest the presence of a hearth feature.

6.11.3 Collection Unit

A 30 x 30 m collection unit (Figure 6.49) was placed to include the majority of artifacts within the discrete scatter as well as those in a more diffuse context. Artifacts in the discrete concentration, but excluded from the surface collection, were located below a major slope change at the mesa edge and were probably slope washed. Owing to the occurrence of artifacts on bedrock deposits, subsurface testing was deemed inappropriate. Although subsurface materials may be present in the sandy deposits south of the site, the major concentration of artifacts was the only area exhibiting any cultural deposits.

Figure 6.49 LA 27002, Abiquiu Archaeological Study, ACOE, 1989.



6.[illegible] 4 Detailed Lithic Analysis

[illegible].1 Discussion

LA 27002 is a small lithic scatter [illegible] a bedrock outcrop. A 30 x [illegible] collection grid was placed over the s[illegible]. No subsurface tests were [illegible]ted.

An examination of the surface artifa[illegible] distribution identified a high [illegible] lithic scatter measuring 9 x 4 m (Prov[illegible]ence 2) within a broader, low [illegible] lithic scatter (Provenience 1).

A total of 451 lithic artifacts was recovered from the site. Ceramic, [illegible] faunal, and ground stone artifacts were not present. The high [illegible] area (Provenience 2) consisted of 306 lithic artifacts while the low [illegible] background distribution included 145 artifacts. Examination of material selection, artifact variability, and tool use indicated that both proveniences exhibited similar lithic assemblages. Due to these similarities the entire lithic assemblage will be discussed as a unit. Any pertinent variation between proveniences is noted.

An examination of material selection on the site (Table 6.38) indicated that Pedernal chert (22[illegible] artifacts, 66 percent) and Polvadera obsidian (136 artifacts, 30 percent) were the primary materials reduced at the site. Sixteen additional artifacts were manufactured from eight different local materials. The materials represented on LA 27002 are typical for sites in the study area.

Table 6.3[illegible] LA 27002 Artifact Type to Material Type Frequencies (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACCE, 1989.

	Artifact Type						
Material Type	Biface	Core	Flake	Projectile Point	Small Angular Debris	Uniface	Total
Brown Jasper	1(50)	--(--)	1(50)	--(--)	--(--)	--(--)	2
Fossiliferous Tan Chert	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	1
Jemez Obsidian	--(--)	--(--)	5(83)	1(17)	--(--)	--(--)	6
[illegible] Green Chert	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	1
[illegible] Miscellaneous Chert	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	1
[illegible] Jasper	--(--)	--(--)	2(100)	--(--)	--(--)	--(--)	2
[illegible] Chert	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	1
[illegible] Chert	2(1)	1(<1)	288(96)	--(--)	8(3)	--(--)	299
[illegible] Obsidian	3(2)	--(--)	129(95)	1(1)	2(1)	1(1)	136
[illegible] Sandstone	--(--)	--(--)	2(100)	--(--)	--(--)	--(--)	2
	6(1)	1(<1)	431(96)	2(<1)	10(2)	1(<1)	451

Pedernal chert was the only material that exhibited evidence of heat treatment. Nonheat treated Pedernal chert made up 33 percent (98 artifacts) of the assemblage, while heat treated materials totaled 67 percent (201 artifacts). Fifty-nine percent of the assemblage was successfully treated while 41 percent exhibited evidence of unsuccessful treatment. Although an attempt was made during the detailed analysis to determine if flakes or cores were heat treated, inconsistencies in the recording of this attribute during the analysis on LA 27002 resulted in a lack of reliable information.

Table 6.39 indicates the type of artifacts that exhibited heat treatment. When various flake types were compared, again uniface and biface flakes exhibit a much higher percentage of successful heat treatment (uniface flakes 73 percent; biface flakes 78 percent) than core flakes (51 percent). These data supported indications from other sites that the majority of formal tools was manufactured from heat treated raw materials. The relatively high frequency of unsuccessfully heat treated materials may indicate that heat treatment occurred at the site since one would not expect unsuccessfully treated materials to be carried away from the heat treatment locus.

Table 6.39 LA 27002 Heat Treatment for Chert to Artifact Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total / Treated	Successful	Unsuccessful	Successful Core	Successful Flake	Total / Successful	Total
Biface Flake	3	18	1	4	4	9	14	21
Biface	--	2	--	1	1	--	1	2
Tested Core	--	1	--	--	1	--	1	1
Core Flake	64	92	--	45	30	17	47	156
Small Angular Debris	3	5	--	4	--	1	1	8
Unidentified Flake	24	72	1	26	8	37	46	96
Unifacially Retouched Flake	4	11	--	3	2	6	8	15
Total	98	201	2	83	46	70	118	299

Ninety-eight percent of the assemblage was comprised of flakes and small angular debris. Other artifacts (six bifaces, two projectile points, one uniface, and one core) made up two percent of the assemblage. The entire site was examined at the detailed level.

An examination of artifact variability across the site indicated that formal tool manufacturing and resharpening occurred. Other limited activities, however, were indicated by the presence of basally-shaped projectile point fragments (two Polvadera bases). The presence of these artifacts in the assemblage suggested that these fragments were removed from their hafts at the

site, which would indicate that the site also served as a returning place after hunting.

Formal tool manufacture is indicated on the site by the incompleted formal tool fragments that were discarded at the site. Five incomplete bifaces, representing both early and late bifacial manufacture, were recovered (Appendix F). Two of these artifacts were manufactured from Pedernal chert and three from Polvadera obsidian. Breakage and manufacturing error resulted in their discard prior to completion. These discarded, incompleted tools were recovered from both surface proveniences.

Formal and expedient tool utilization is indicated on LA 27002. The use of formal tools at the site is indicated by the discard of a completed uniface. Artifacts with unidirectional marginal retouch were recovered from Provenience 1 (three artifacts) and Provenience 2 (one artifact). A single flake tool with use wear indicating scraping activities was also recovered (Provenience 1). All complete and utilized tools indicate that scraping activities were carried out at the site. There was no evidence of cutting activities.

Although ground stone artifacts were not recovered from the site, a flake from a ground stone sharpener (pecking stone) with dorsal patterning indicates that grinding activities probably occurred.

6.11.4.2 Lithic Summary and Site Activities

The lithic assemblage recovered from LA 27002 indicates the site was used for the reduction of raw materials and the manufacture of formal tools as well as a number of use activities. Scraping activities and minimal evidence of grinding activities were identified. The presence of basal projectile point fragments suggests that hunting occurred in the near vicinity. The presence of successfully and unsuccessfully heat treated artifacts indicates that heat treatment probably occurred at the site.

6.11.5 Summary

Approximately 451 lithic artifacts were collected from the surface of LA 27002. The majority of these was recovered from an approximately 68-m^2 area at the north edge of the mesa. These included two unidentified projectile points. Both appeared to represent the same stylistic type and exhibited stems with a slightly convex base. Both were morphologically suggestive of dart points occurring in middle to late Archaic contexts. One was located within the artifact concentration while the other was located to the southwest. See Chapter 7 for further details on chronology based on obsidian hydration.

A total of 900 m^2 was examined for cultural materials. The lack of artifacts along the deflated edge of soil deposits indicated that the site probably did not extend into these deposits; hence, no testing was carried out at this site. It is likely that the sparse scatters observed in the southernmost deflated zone and in the adjacent undeflated area are unrelated to the concentration collected from LA 27002.

6.12 LA 27004

6.12.1 Physiographic Setting

This site is a small lithic scatter situated atop and on the western slope of a low, northeast-southwest trending ridge lying northwest of Arroyo del Chamiso at an elevation of 6270 feet. Locally south trending, intermittent drainages to the east and west of the ridge join the Rio Chama approximately 600 m to the west. Stable, sandy loams are deposited on the top of the ridge while the slopes exhibit stable and eroded areas where deep sheet wash has exposed gravel covered clays and shales. Artifacts are located on stable sands and in a shallow, erosional swale. The site has been truncated on the north by fill and bar ditch construction of old U. S. Highway 84 (Figure 6.50).

6.12.2 Previous Work

The original survey (Schaafsma 1976:48-51) describes the site as an 80 x 40 m, single-component lithic scatter which contained an En Medio style projectile point which was collected. One discrete artifact concentration was mapped on the west slope of the ridge. Revisitation in 1982 (Reed et al. 1982:21-22, 34-35) resulted in the location of two artifact concentrations on the western and eastern slopes. Both were interpreted as the result of downslope erosion. The site was staked and a test pit excavated in a "dense flake scatter" in 1982 by Nickens and Associates (Reed et al. 1982:21-22, 34-35).

6.12.3 Field Methods

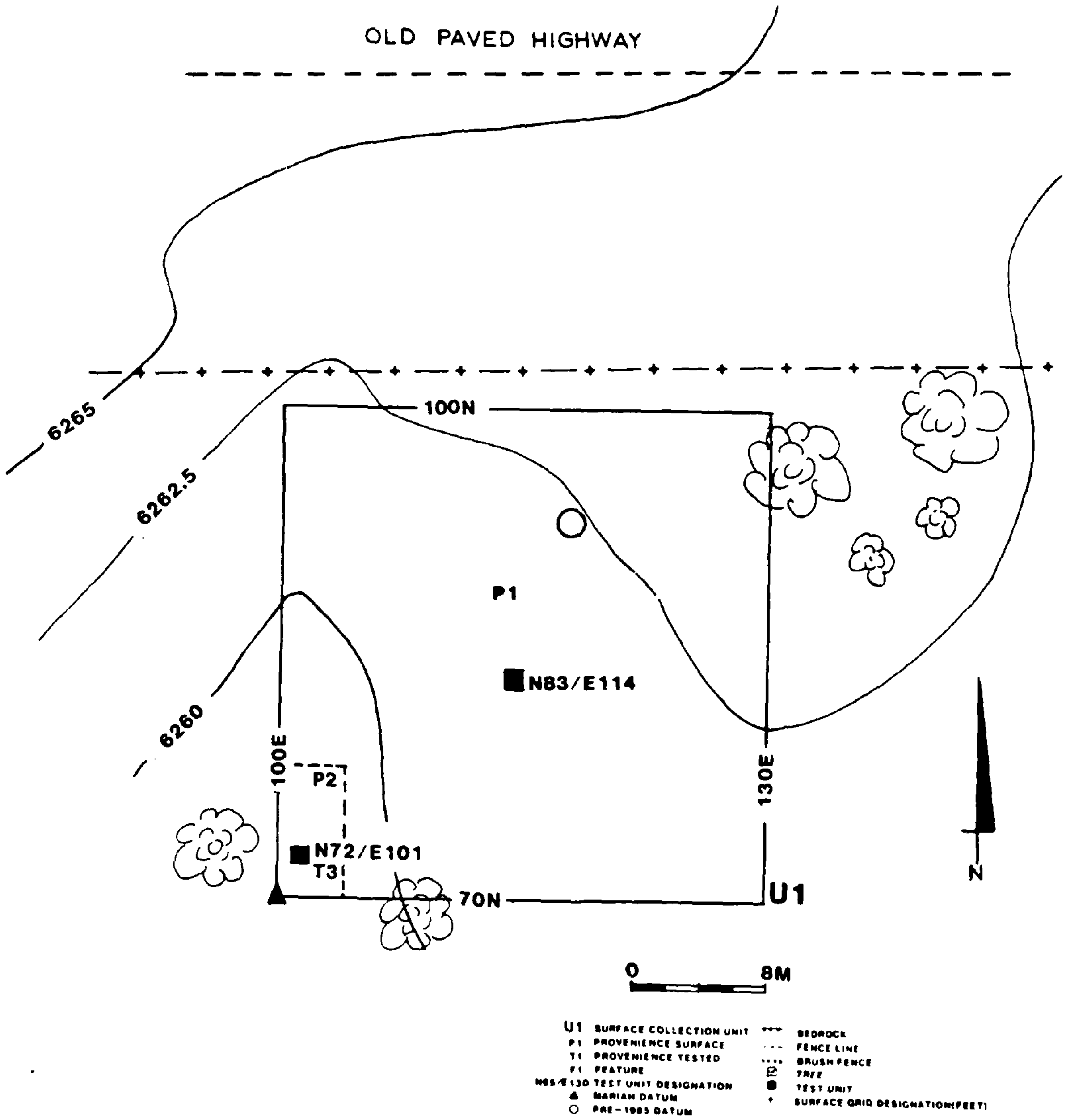
Reexamination of the site area during this project located one discrete artifact concentration on the western slope of the ridge, lying in the southwestern portion of a diffuse scatter extending about 45 m across the top and 30 m along the side of the ridge. The concentration was greatest in a shallow swale devoid of vegetation and covered with small (2 x 1 x 1 cm) gravels suggestive of recent colluvial erosion. This area was immediately adjacent to the Abiquiu Lake edge. The eastern concentration reported in the 1982 project could not be relocated, but its reported area exhibited evidence of sheet wash; it is likely that erosional processes have totally removed any artifacts from this area. The original datum was relocated, but no evidence of the test pit or its surrounding "dense" scatter was found.

6.12.4 Collection Units

A 30 x 30 m surface collection was laid out to cover the majority of the site area, including the observed lithic concentration as well as the diffuse scatter on the top and western sides of the ridge.

Approximately 276 lithic artifacts were recovered during surface collection. One hundred and fifty of these came from the roughly 33-m^2 concentration in the southwest portion of the site area. The surface density in this concentration reached a maximum of 15 items/m^2. The majority of the remaining items was present in a diffuse scatter covering an approximately 300-m^2 area

Figure 6.50 LA 27004, Abiquiu Archaeological Study, ACOE, 1989.



on the top and side of the ridge in the northern portion of the site. Densities reached a maximum of six items/m^2 in this diffuse scatter.

6.12.5 Subsurface Samples and Stratigraphy

Two 1 x 1 m test pits were excavated to determine the depths of cultural deposits; both employed 1/4-inch screen. Samples are described in Table 6.40. One unit was located at grid 72N/101E within the southwestern lithic concentration. It was designed to determine whether the artifacts were eroding from an original deposit or if the scatter was the result of erosional and sorting processes. The unit was excavated in arbitrary 10-cm levels to a 25-cm depth.

Table 6.40 LA 27004 Samples, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
N72/E101, Level 2	1	1	--
N83/E114, Level 2	1	1	--

This test pit yielded a total of 24 subsurface lithics. The majority of these (17) was located in the upper 10-cm level. The subsurface matrix consisted of a red sandy clay intermixed with small (2 x 2 x 1 cm) and moderate-sized (10 x 10 x 5 cm) gravels. This matrix was homogeneous to a depth of around 25 cm; lower deposits consisted of dense, pea-sized (1 x 1 x 1 cm) gravels intermixed with weathered shale (Figure 6.51). The density of the well-sorted gravels and the presence of shale suggested an old erosional surface. As a consequence, further excavation was deemed inappropriate.

An additional test unit was located at grid 83N/114E on a stable, sandy surface in an area which lacked surface materials. Testing in this area was chosen to determine if deposition underlay the surface and to evaluate the significance of a possible tipi ring or rock alignment. This unit was excavated in 10-cm arbitrary levels to a depth of 35 cm.

Test pit 83N/114E recovered no subsurface artifacts. The upper 10 cm of deposits were caliche nodules, pebbles, and sandstone spalls intermixed with a red/brown, sandy loam. Below this was a coarse, clean, water-laid sand which contained small gravels (Figure 6.52). A 10-cm level was excavated into this lower matrix; as no artifacts were recovered, excavations were terminated.

6.12.6 Rough Sort and Detailed Lithic Analysis

LA 27004 represents a small lithic scatter with one moderately dense concentration and a low density background scatter. A 30 x 30 m surface collection unit was placed over the majority of the scatter.

Figure 6.51 LA 27004, N72/E101, East Wall Profile, Abiquiu Archaeological Study, 1989.

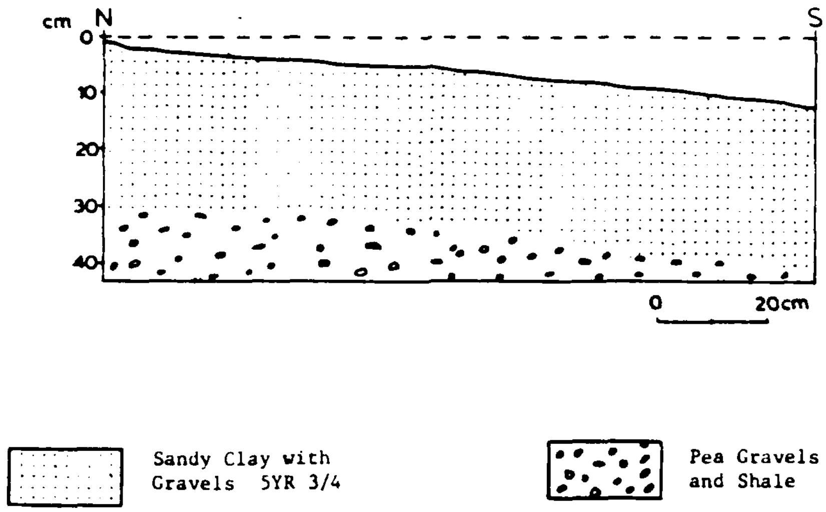
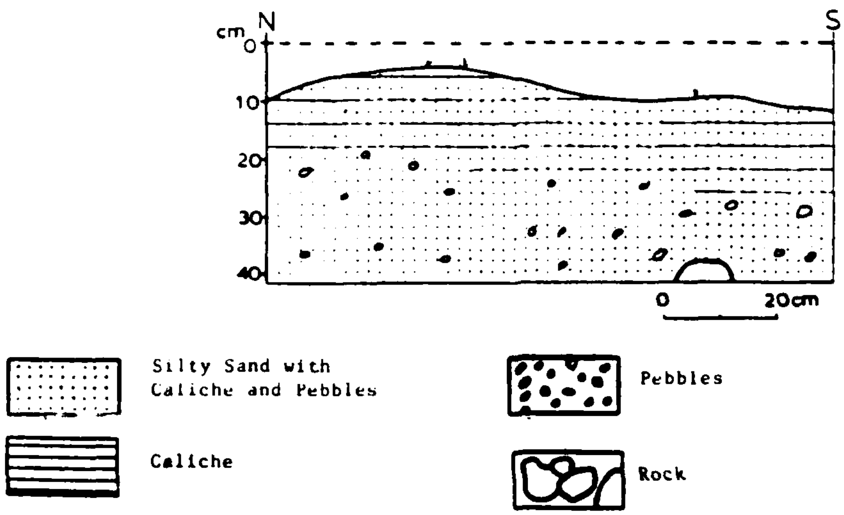


Figure 6.52 LA 27004, N83/E114, East Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



Surface density maps were examined to determine if activity areas could be identified. On the basis of these maps, a concentration was identified in the southwest corner of Unit 1 (Provenience 1). The remaining low density scatter in Unit 1 was described as Provenience 2. Provenience 3 represents materials recovered from a test pit in Provenience 1 (72N/101E). A second test pit located in 83N/114E produced no artifactual materials.

A total of 300 chipped stone artifacts was recovered from the site (Table 6.41). These artifacts included 291 flakes and pieces of small angular debris, eight bifaces, and one uniface. Ground stone, ceramics, and faunal and historic artifacts were not present.

Table 6.41 LA 27004 Material Type to Artifact Type Frequencies (Row Percentage in Parenthesis), Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type				
Material Type	Biface	Flake	Small Angular Debris	Uniface	Total
Morrison Green Chert	--(--)	1(100)	--(--)	--(--)	1
Pedernal Chert	7(2)	273(97)	1(<1)	1(<1)	282
Polvadera Obsidian	--(--)	8(100)	--(--)	--(--)	8
Quartzitic Sandstone	1(11)	8(89)	--(--)	--(--)	9
Total	8(3)	290(97)	1(<1)	1(<1)	300

A detailed analysis was conducted on a sample from both surface proveniences. Sixty-three artifacts from Provenience 1 and 44 from Provenience 2 underwent this analysis. The rough sort data for each provenience are discussed. Information gained from the detailed analysis is included where applicable.

Table 6.42 describes heat treatment in the assemblage. Pedernal chert was the only material type that exhibited heat treatment. Ninety percent of the assemblage (255 artifacts) exhibited heat treatment. Of these, 88 percent were successfully treated (225 artifacts). Table 6.42 indicates that a high percentage of core flakes as well as biface flakes exhibited heat treatment. Among many assemblages high percentages of biface flakes were treated, while less evidence of heat treatment was found on core flakes. In this assemblage this did seem to be the case. Between 81 percent and 89 percent of all flakes and bifaces were heat treated.

The lithic concentration in the southwest corner of Unit 1 (Provenience 1) consisted of 131 flakes. No other chipped stone artifacts were recovered. The majority of this assemblage consisted of Pedernal chert and appeared to represent a Pedernal reduction area.

Table 6.42 LA 27004 Heat Treatment for Pedernal Chert to Artifact Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total / Treated	Successful	Unsuccessful	Successful Core	Successful Flake	Total / Successful	Total
Biface Flake	4	48	44	1	3	--	47	52
Biface	--	7	6	--	--	1	7	7
Core Flake	8	46	32	13	1	--	33	54
Small Angular Debris	1	--	--	--	--	--	--	1
Unidentified Flake	14	148	121	15	12	--	133	162
Unifacially Retouched Flake	--	5	2	1	2	--	4	5
Uniface	--	1	--	--	1	--	1	1
Total	27	255	205	30	19	1	225	282

An examination of platform use versus preparation on retouched platforms indicated that formal tools were manufactured and resharpened in the area. Three Pedernal flakes exhibited remnants of use on retouched platforms. Use occurred on unidirectionally and bidirectionally retouched platforms indicating that both tool types were resharpened. There were no formal tools recovered from this area.

The assemblage recovered from the Pedernal concentration (Provenience 1) indicates formal tool manufacture and resharpening. Use on retouched platforms indicates that formal tools were probably used at the site. Evidence of expedient tool utilization is also present. Prepared cores may have been reduced in this area.

6.12.6.1 Unit 1, Provenience 2

Provenience 2 represented the general low density lithic scatter in Unit 1. A total of 147 chipped stone artifacts was recovered from this area. Artifact variability in this area was greater than that identified in Provenience 1. Artifacts included 138 flakes and pieces of small angular debris, eight bifaces, and one uniface.

The material types represented in this provenience were slightly more varied than those identified in Provenience 1. Although Pedernal chert comprised the majority of the assemblage (90 percent, 133 artifacts), Polvadera obsidian made up five percent (eight artifacts), quartzitic sandstone three percent (five artifacts), and Morrison chert one percent (one artifact). The material type variability identified in this provenience was similar to the variability identified in general multicomponent lithic scatters on other

sites. The limited variability identified in Provenience 1 on this site usually represents a discrete reduction episode.

Eight formal tools were recovered and included two biface blanks, three early bifaces, two late bifaces, and one thumb nail scraper (Appendix F). All but one tool were manufactured from Pedernal chert. One early biface was manufactured from quartzitic sandstone. The lack of incomplete tools manufactured from Polvadera obsidian supports other evidence that Polvadera obsidian tools were not manufactured in this area.

One Pedernal biface blank lacked evidence of heat treatment. This may indicate that early stages of bifacial manufacture were carried out on both heat treated and nonheat treated bifaces.

The assemblage from Provenience 2 is similar to the Provenience 1 assemblage. Although slightly greater material variability was identified in Provenience 1, both assemblages represent formal tool manufacture and use. Expedient tool utilization is indicated as well.

6.12.6.2 Unit 1, Provenience 3

Provenience 3 was a subsurface test pit located in the Pedernal chert concentration (Provenience 1) to determine if subsurface deposits were similar to those identified on the surface.

A total of 22 Pedernal flakes was recovered from this excavation. The subsurface assemblage lacked evidence of primary decortication. No evidence of formal or expedient tool use was identified. These data indicated that although the entire subsurface assemblage was Pedernal chert, it represented a strictly defined formal tool manufacturing area which lacked evidence of tool utilization.

6.12.6.3 Lithic Summary of Activity Areas

The assemblages recovered from LA 27004 indicate that surface and subsurface content varies. The subsurface assemblage appears to represent a limited activity area (formal tool manufacturing), while the surface of the site clearly represents formal tool manufacturing, resharpening, and utilization, as well as expedient tool use. Although Provenience 1 represents a discrete Pedernal concentration, the assemblage character is similar to that identified in the general surface lithic scatter.

6.12.7 Ceramics, Bone, Historic Items

No ceramic or bone items were encountered at this site. Historic items observed but not collected pertain to the construction of a steel-post, barbed wire fence at the north site boundary; these items, also noted in 1982 by the Nickens and Associates (Reed et al. 1982:21-22, 34-34) crew, clearly were deposited within the last two to three decades.

6.12.8 Summary

A total of 300 lithic artifacts was recovered from one of two test pits, a small surface concentration, and a diffuse surface scatter. These did not include any tools diagnostic of temporal or cultural association although the original survey (Schaafsma 1976:48-51) reported an En Medio style projectile point. Shallow subsurface materials were present in the artifact concentration but proved to be absent in one interior area which lacked surface materials. No surface or subsurface features were encountered.

6.13 LA 25532

6.13.1 Physiographic Setting

This lithic and ceramic scatter is located at an elevation of 6350 feet and approximately 400 m east of the Rio Chama. The site is situated on the eastern slope of a north-south trending ridge. Short, intermittent, northeast trending drainages have created a series of low, northeast-southwest trending ridges on the eastern slope of the north-south ridge. Artifacts were present on two such adjacent ridges and in the two accompanying ephemeral drainages. The ridge tops appeared to be mantled with a sandy loam while sides of ridges and the drainage areas contained exposed sandstone bedrock. The site is located adjacent to an improved campground and the turnoff to the unimproved boat ramp facility. A fence was present at the western and southern edges of the site and marked the campground and temporary boat ramp access.

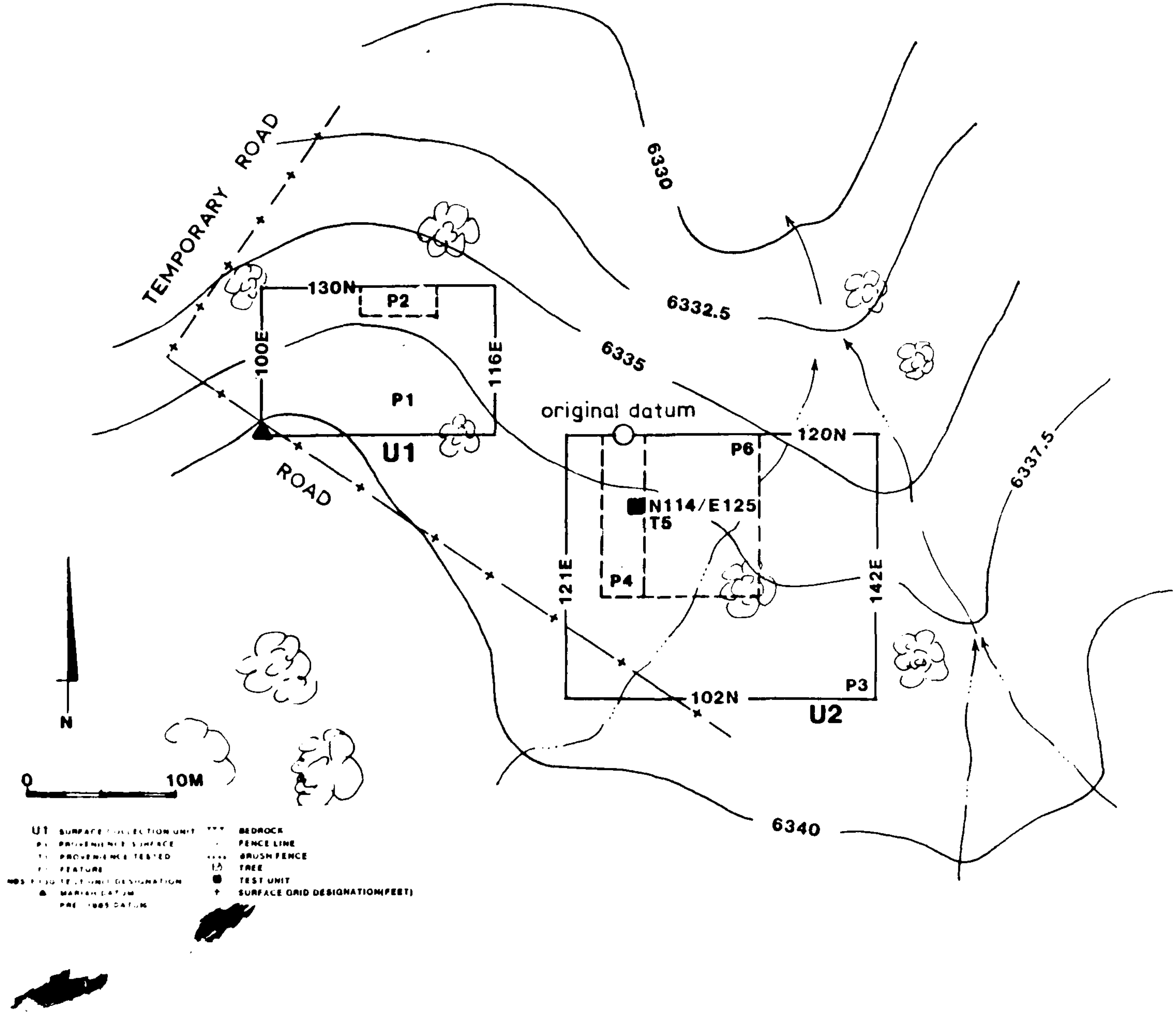
6.13.2 Previous Work

The original survey (Klager 1980:19, 72-73) reported this site as an approximately 5,800-m^2 lithic scatter with an estimated artifact complement of 275 items. Revisitation (Reed et al. 1982:110-111, 117) in 1982 extended the site boundary beyond the fence and to the west and reported the presence of fire-cracked rock. The site was also tested in 1982, and subsurface artifacts and features were present.

6.13.3 Field Methods

Examination of the site area during this project indicated that the site had previously been incorrectly plotted, and suggested the existence of artifact concentrations whose distinctiveness was exaggerated by the presence of a small, bedrock-entrenched drainage between the concentrations (Figure 6.53). The concentrations were located within a diffuse, 4,600-m^2 artifact scatter, which extended downslope and to the northeast. The northeastern concentration contained ceramic as well as lithic artifacts. No fire-cracked rock or burned sandstone was present. Ash was present in the southernmost drainage and appeared to be of recent origin. It is likely that the site did extend upslope to the south; road construction and visitation have obscured these evidences.

Figure 6.53 LA 25532, Abiquiu Archaeological Study, ACOE, 1989.



6.13.4 Collection Units

Collection Unit 1 was a 10 x 15 m unit in the northwestern portion of the site. This unit was on a southeastern slope, north of a small drainage. Ceramic and lithic artifacts were observed in this area lying on a mostly soilless matrix of cobbles and sandstone fragments. Sandstone bedrock was exposed in some areas of the surface collection unit which was placed to examine this distribution.

Collection Unit 2 consisted of 240 m^2 and included a small ridge and drainage. Deposits on the ridge consisted of sandy loams while colluvially washed sands and rounded cobbles and sandstone bedrock were present in the shallow drainage. The unit was chosen to monitor subsurface conditions in the area of a reported Nickens and Associates test excavation (Reed et al. 1982:110-111, 117).

Approximately 990 artifacts were collected from the surface. These included one Archaic projectile point and 20 Valdito micaceous ceramics (Dick 1965). Collection Unit 1 contained ceramics dating from A.D. 1600 to 1900 and 162 lithic artifacts. The surface distribution did not suggest any discrete concentration except for a 6-m^2 area which contained most of the ceramic materials. This small area also exhibited the highest artifact density of Unit 1, with 12 items/m^2.

Collection Unit 2 recovered approximately 809 lithic artifacts including the diagnostic projectile point. This area appeared to have an overall moderate surface density with a higher density in the northeastern portion of the collection unit. The maximum surface density for Unit 2 was 21 items/m^2.

6.13.5 Subsurface Samples and Stratigraphy

One test pit was located at 114N/125E within collection Unit 2 and was situated near the reported location of the Nickens 1982 test on the ridge top. Materials were screened through 1/4-inch mesh. Samples are listed in Table 6.43. This unit was excavated to a maximum 20-cm depth. It was chosen to further evaluate previous reports (Reed et al. 1982) of subsurface deposition.

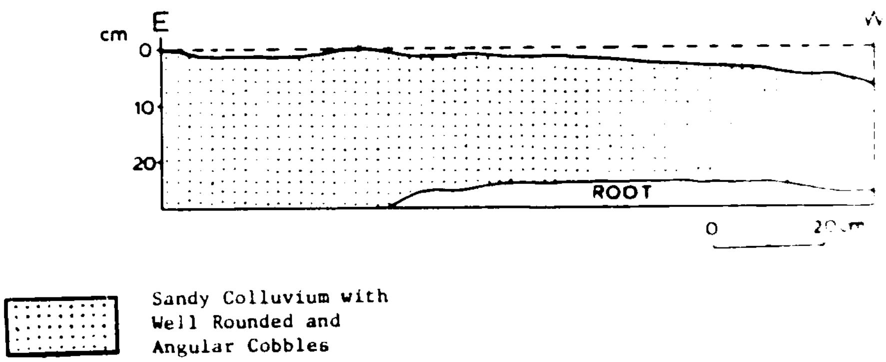
Table 6.43 LA 25532 Samples, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
N114/E125, Level 2	1	1	--

Twenty-nine subsurface lithic artifacts were present in the test pit. All but five of these were located in the upper 10-cm level in a sandy, colluvial matrix. This matrix also contained rounded cobbles 10 to 15 cm long and angular sandstone fragments. No artifacts were located deeper than 15 cm

below the present ground surface (Figure 6.54). Excavations were term... at a 20-cm depth.

Figure 6.54 LA 25532, N114/E125, South Wall Profile, Abiquiu Ar... Study, ACOE, 1989.



6.13.6 Rough Sort and Detailed Lithic Analysis

LA 25532 is a lithic and ceramic scatter collected ... s: Unit 1, a 10 x 15 m surface area in the northwest por... and Unit 2, a 240-m^2 surface unit which included a small ridge ...

6.13.6.1 Introduction

Surface density maps resulted in the identific... all lit... concentration in Unit 1 and two concentrations in Un... included general low density scatter (Provenience 1) and a sma... oncentra... in grids 128-129N/107-111E (Provenience 2) at the nor... edge. Un... included a general low density scatter (Proven... Pedernal ... concentration located in 109-119N/123-125E (Proven... and an obs... concentration located in 108-119N/126-134E (Proven... A single s... face test pit (114N/125E) was placed in Provenience ... determine if ... face deposits were present. This test is repor... venience 5.

A total of 993 chipped stone artifacts was ... from LA 255... 6.44). These artifacts represent considerable ...versity and ... flakes and pieces of small angular debr... es, one un... drills, two projectile points, six cores, 2... large ang... and seven miscellaneous items. Four pieces ... stone ... covered. A number of ceramics was identifie... 11). ... or faunal remains were found.

Table 6.44 LA 25532 Material Type to Artifact Type Frequencies (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

Material Type	Biface	Cores	Drill	Flakes	Large Angular Debris	Miscellaneous	Projectile Point	Small Angular Debris	Uniface	Total
Miscellaneous	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1
Brown Jasper	--(--)	--(--)	--(--)	3(100)	--(--)	--(--)	--(--)	--(--)	--(--)	3
Fossiliferous Tan Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1
Jemez Obsidian	--(--)	--(--)	--(--)	18(95)	--(--)	--(--)	--(--)	1(5)	--(--)	19
Miscellaneous Chert	--(--)	--(--)	--(--)	2(100)	--(--)	--(--)	--(--)	--(--)	--(--)	2
Moss Jasper	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1
Nacimiento Chert	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1
Pedernal Chert	11(2)	6(1)	--(--)	447(82)	19(4)	6(1)	--(--)	53(10)	1(<1)	543
Polvadera Obsidian	5(1)	--(--)	3(1)	390(95)	--(--)	1(<1)	2(<1)	8(2)	--(--)	409
Quartzitic Sandstone	--(--)	--(--)	--(--)	2(67)	1(33)	--(--)	--(--)	--(--)	--(--)	3
Quartzite	--(--)	--(--)	--(--)	4(100)	--(--)	--(--)	--(--)	--(--)	--(--)	4
Quartz	--(--)	--(--)	--(--)	3(100)	--(--)	--(--)	--(--)	--(--)	--(--)	3
Vitrophyre	--(--)	--(--)	--(--)	3(100)	--(--)	--(--)	--(--)	--(--)	--(--)	3
Total	16(2)	6(1)	3(<1)	876(88)	20(2)	7(<1)	2(<1)	62(6)	1(<1)	993

A detailed analysis was conducted on 252 artifacts from the site. The areas that were selected for detailed samples were chosen on the basis of field density maps. Detailed samples were selected from the two concentrations in Unit 2 (Provenience 3, 66 artifacts and Provenience 6, 185 artifacts). Information gained from these samples is discussed with the rough sort data when applicable.

Heat treatment occurred on Pedernal chert. Eighty-three percent of these materials were treated (453 artifacts). Only 17 percent (90 artifacts) lacked evidence of heat treatment. Seventy percent of the heat treated artifacts were successfully treated while 30 percent exhibited evidence of unsuccessful treatment. These data suggest that heat treatment occurred at or near the site. If heat treatment occurred at another location, one would not expect this high percentage of unsuccessfully treated materials at the site.

Table 6.45 describes heat treatment and artifact type. This table shows that formal tool manufacture generally occurred on heat treated Pedernal chert. All biface flakes were treated, while a single pressure flake lacked evidence of heat treatment. Core reduction was carried out on both treated

and nontreated chert. Eighty-one percent of the core flakes recovered were heat treated. These data suggest that bifacial tool manufacture was generally carried out on heat treated Pedernal chert and that core reduction occurred on both treated and nontreated materials.

Table 6.45 LA 25532 Heat Treatment for Chert to Artifact Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total # Treated	Successful	Unsuccessful	Successful Core	Successful Flake	Total # Successful	Total
Miscellaneous	1	--	--	--	--	--	--	1
Biface Flake	--	17	17	--	--	--	17	17
Biface	--	11	8	3	--	--	8	11
Multiplatform Core	--	4	3	--	1	--	4	4
Tested Core	1	1	1	--	--	--	1	2
Core Flake	59	248	158	85	5	--	163	307
Heat Spall	--	5	--	5	--	--	--	5
Large Angular Debris	7	12	7	5	--	--	7	19
Pressure Flake	1	2	--	--	2	--	2	3
Small Angular Debris	9	44	19	25	--	--	19	53
Unidentified Flake	12	101	78	12	8	3	89	113
Unifacially Retouched Flake	--	7	--	2	5	--	5	7
Uniface	--	1	1	--	--	--	1	1
Total	90	453	292	137	21	3	316	543

The following section discusses the lithic concentrations then the low density scatter in each unit.

6.13.6.2 Unit 1, Provenience 2

Provenience 2 represents a small obsidian concentration in Unit 1. A total of 38 chipped stone artifacts was recovered from this area. Artifacts included 36 flakes, one drill, and one piece of large angular debris. The assemblage was primarily composed of Polvadera obsidian (84 percent, 32 artifacts). A single piece of Jemez obsidian and five pieces of Pedernal chert were also recovered.

Two formal tools (one drill and one marginally retouched artifact), manufactured from Polvadera obsidian, were recovered from this area. It was not possible to determine if the drill represented a completed tool or a manufacturing failure. The other artifact exhibited extensive unidirectional marginal retouch and morphology indicating that it was discarded prior to completion.

Expedient tool use was indicated by a single flake with unidirectional use. This tool indicated that scraping activities were carried out in the area. The preponderance of secondary reduction debitage in addition to evidence of expedient tool use suggested that this was a tool use area in addition to a manufacturing location. The amount of cortical debris indicated that all stages of material reduction occurred.

6.13.6.3 Unit 1, Provenience 1

Provenience 1 was the general low density assemblage that was recovered from Unit 1. One hundred and thirty-three chipped stone artifacts were recovered from this area. These included 118 flakes and pieces of small angular debris, three bifaces, three cores, and eight pieces of large angular debris. One misclassified artifact was included. No ground stone was identified.

Sixty-two percent of the assemblage was Pedernal chert (83 artifacts) while Polvadera obsidian made up 29 percent of the assemblage (38 artifacts). The remaining nine percent represented five material classes. Of these a single flake was manufactured from vitrophyre basalt that is known to occur in the San Antonio Mountains. The other artifacts were manufactured from locally available materials.

Three multiplatform cores were recovered. They were all manufactured from successfully heat treated Pedernal chert and indicated a random technique of core reduction.

Apparently, the formal tool manufacture of Polvadera obsidian occurred while Pedernal chert formal tool manufacture was lacking. The five formal tools recovered from Provenience 1 included one bifacial blank, one early biface, one bifacial tool, one projectile point, and one artifact with extensive bidirectional retouch (Appendix F). All were manufactured from Polvadera obsidian with the exception of a Pedernal chert bifacial tool. It appears that this bifacial tool was manufactured at another location. It exhibited successful heat treatment.

With the exception of the projectile point fragments, all other Polvadera obsidian formal tools represent manufacturing failures. These data support debitage evidence that Polvadera obsidian formal tools were manufactured in this location.

The assemblage that was recovered from this area of the site indicates that Polvadera obsidian formal tools were manufactured and expedient flake tools were used in scraping and cutting activities. The assemblage of Pedernal chert on the other hand clearly indicates primary decortication and lacks evidence of formal tool manufacture. The Pedernal bifacial tool may have been used at this location, but it was not manufactured in this area.

6.13.6.4 Unit 2, Provenience 4

Provenience 4 is a Pedernal chert concentration in the northwest corner of the unit. A total of 158 chipped stone artifacts was recovered from this area. A single mano fragment was also recovered. The chipped stone included

149 flakes and pieces of small angular debris, four bifaces, one core, and three pieces of large angular debris. One item was misclassified.

The assemblage was comprised primarily of Pedernal chert (81 percent, 128 artifacts) and Polvadera obsidian (15 percent, 23 artifacts). Four percent of the assemblage represented seven material classes and included seven artifacts. All materials are locally available with the exception of one vitrophyre basalt flake; this material is known to occur in the San Antonio Mountains.

One tested core was recovered from this area. It was manufactured from nonheat treated Pedernal chert and indicates that raw materials were close at hand.

Five formal tools were recovered from Provenience 4. They included one blank, three early bifaces, and one late biface. The blank was manufactured from Polvadera obsidian, and the remaining artifacts were manufactured from Pedernal chert. Although the debitage indicated limited evidence of the manufacture of Pedernal formal tools, the presence of four Pedernal manufacturing failures in this area indicated that formal tool manufacture did occur.

Two early bifaces exhibited unsuccessful heat treatment. These artifacts indicated that heat treatment occurred following the initial stages of biface production. The presence of these bifaces in addition to early heat treated bifaces suggested a dual strategy of heat treatment.

A single flake manufactured from Polvadera obsidian exhibited utilization. This flake tool had bidirectional wear indicating use in a cutting motion.

6.13.6.5 Unit 2, Provenience 5

Provenience 5 represented the subsurface test pit placed in the Provenience 4 concentration. Twenty-seven artifacts were recovered from this test. Most were found in the upper 10 cm. Artifacts included 26 flakes and pieces of small angular debris, one core, and one piece of large angular debris.

The subsurface assemblage exhibited percentages of materials that are similar to the surface assemblage. Seventy percent (19 artifacts) of the assemblage was Pedernal chert while 19 percent (five artifacts) was Polvadera obsidian. The Pedernal assemblage exhibited 26 percent cortical debris while all of the Polvadera obsidian lacked cortex. Each material class exhibited a flake with a retouched platform indicating that formal tool manufacture occurred. No evidence of resharpening was identified. No formal tools were recovered. The presence of a flake with dorsal battering indicates that grinding activities are represented.

6.13.6.6 Unit 2, Provenience 6

Provenience 6 was an obsidian concentration in the northeast corner of Unit 2. Chipped stone artifacts totaled 472, and two pieces of ground stone

were also recovered. Chipped stone included 458 flakes and pieces of small angular debris, five bifaces, two drills, and four pieces of large angular debris. Three items were classified as nonobsidian tools.

The formal tools recovered from this area indicated that Pedernal chert and Polvadera obsidian tools were manufactured in the area. One completed bifacial tool suggested that formal tools were also utilized. The nine formal tools that were recovered included one blank, four early bifaces, one late biface, one bifacial tool, one drill, and an artifact with extensive unidirectional retouch Two artifacts were manufactured from Polvadera obsidian (one blank and one late biface). The seven other artifacts were manufactured from Pedernal chert. Two early bifaces exhibited unsuccessful heat treatment suggesting that these tools were heated as bifaces, not prior to early bifacial manufacture. All other Pedernal artifacts exhibited successful heat treatment.

Eight artifacts exhibited morphology that indicated they were manufacturing failures. These tools were manufactured from both Polvadera obsidian and Pedernal chert supporting other evidence of formal tool manufacture within each material class.

Three flake tools indicated that expedient tool use occurred at the location. Two exhibited unidirectional use wear indicating scraping while one had bidirectional wear indicating cutting. Two additional flakes exhibited dorsal battering suggesting that grinding activities probably occurred at the location. The presence of two mano fragments representing two separate tools supported this evidence.

The lithic assemblage recovered from Provenience 6 was generally similar to other proveniences on the site. Formal tool manufacture was indicated for both Pedernal chert and Polvadera obsidian. Unlike other assemblages, equal amounts of Pedernal chert and Polvadera obsidian were represented. In addition, the resharpening of Polvadera and Pedernal formal tools was indicated. Although some formal tool use was indicated, the expedient use of tools was more common.

6.13.6.7 Unit 2, Provenience 3

Provenience 3 was the low density background scatter in Unit 2. The lithic materials recovered from this area included 165 chipped stone artifacts. These artifacts included 152 flakes and pieces of small angular debris, five bifaces, one uniface, one projectile point, one core, and three pieces of large angular debris. Two items were misclassified.

The materials represented in this area were similar in proportion to those identified in Provenience 6. Almost equal amounts of Pedernal chert (56 percent, 92 artifacts) and Polvadera obsidian (41 percent, 67 artifacts) were recovered. Six additional artifacts were manufactured from three material classes. All materials were locally available.

Both Polvadera obsidian and Pedernal formal tools were recovered from Provenience 3. All but one of the projectile point fragments were incomplete

indicating that formal tool manufacture occurred. Formal tools included three early bifaces, two late bifaces, and one projectile point. All of the Pedernal artifacts exhibited successful heat treatment.

The projectile point fragment represented the basal portion of a corner-notched palmate dart. This type of basal snap was characteristic of an impact fracture and indicated that the fragment may have been removed from its haft at the site.

Expedient tool use was indicated by three flake tools with use wear. Two exhibited bidirectional wear indicating cutting activities and two unidirectional wear indicating scraping activities. The presence of an additional flake with dorsal battering suggested that grinding activities may have also occurred.

The assemblage recovered from this area was similar to the Provenience 6 concentration. Formal tool manufacture was indicated by Pedernal chert and Polvadera obsidian. Although some evidence of formal tool use was indicated, expedient flake tool activities predominated.

6.13.6.8 Lithic Analysis Summary and Site Activity Areas

The lithic assemblage that was recovered from LA 25532 represented a number of concentrations characterized by high percentages of obsidian or Pedernal chert. These concentrations appeared to occur against a background scatter. In general, all assemblages indicated formal tool manufacture of Pedernal chert and Polvadera obsidian. Primary reduction was indicated for both material types; however, cortical debris was limited among Polvadera obsidians. Although some evidence of formal tool use was indicated, the majority of use activities was represented by expedient flake tools. These tools represented scraping and cutting. Additional activities were represented by three drills and four pieces of ground stone.

Proveniences 3 and 6 of Unit 2 appeared most similar. In both cases similar amounts of Pedernal chert and Polvadera obsidian were represented. In other areas of the site, Pedernal chert generally represented more than 70 percent of the assemblage.

6.13.7 Ceramics, Bone, Historic Items

Ceramics at LA 25532 were restricted to 20 sherds of Valdito Micaceous ware (Chapter 11), a surprising observation in light of the proximity of Riana Ruin, a Coalition Period site tree-ring dated to early and mid-1300s. Neither bone nor historic artifacts were recovered from this site.

6.13.8 Summary

This multicomponent site contained ceramics dating from A.D. 1600 to present and projectile points dating to the first millenium A.D. Approximately 1,020 artifacts were recovered from a 390-m^2 surface collection and one 1 x 1 m test pit. The results of the excavation suggested that subsurface materials are present in the site area. Although no excavations were con-

ducted in the vicinity of the ceramics (collection Unit 1), the bedrock and gravels in this area indicated that materials were surficial. Chapters 7 and 8 provide further details on site occupational history, based on obsidian hydration results.

6.13.9 Recommendations

Adverse impacts to the site due to reservoir user visitation should be determined by mapping, collection, and testing.

6.14 LA 51700

6.14.1 Physiographic Setting

LA 51700 is situated on a relatively broad, level area near the crest of a low, southwest-northeast trending ridge. The site lies at an elevation of between approximately 6285 and 6300 feet and is bordered by a steep downslope to the north and northwest. The now-flooded bed of Comales Arroyo is about 400 m north of the site, and the Chama River channel is approximately 1 km to the west. LA 51702 and LA 51703 are situated to the northwest of LA 51700 while LA 51701 is located to the south.

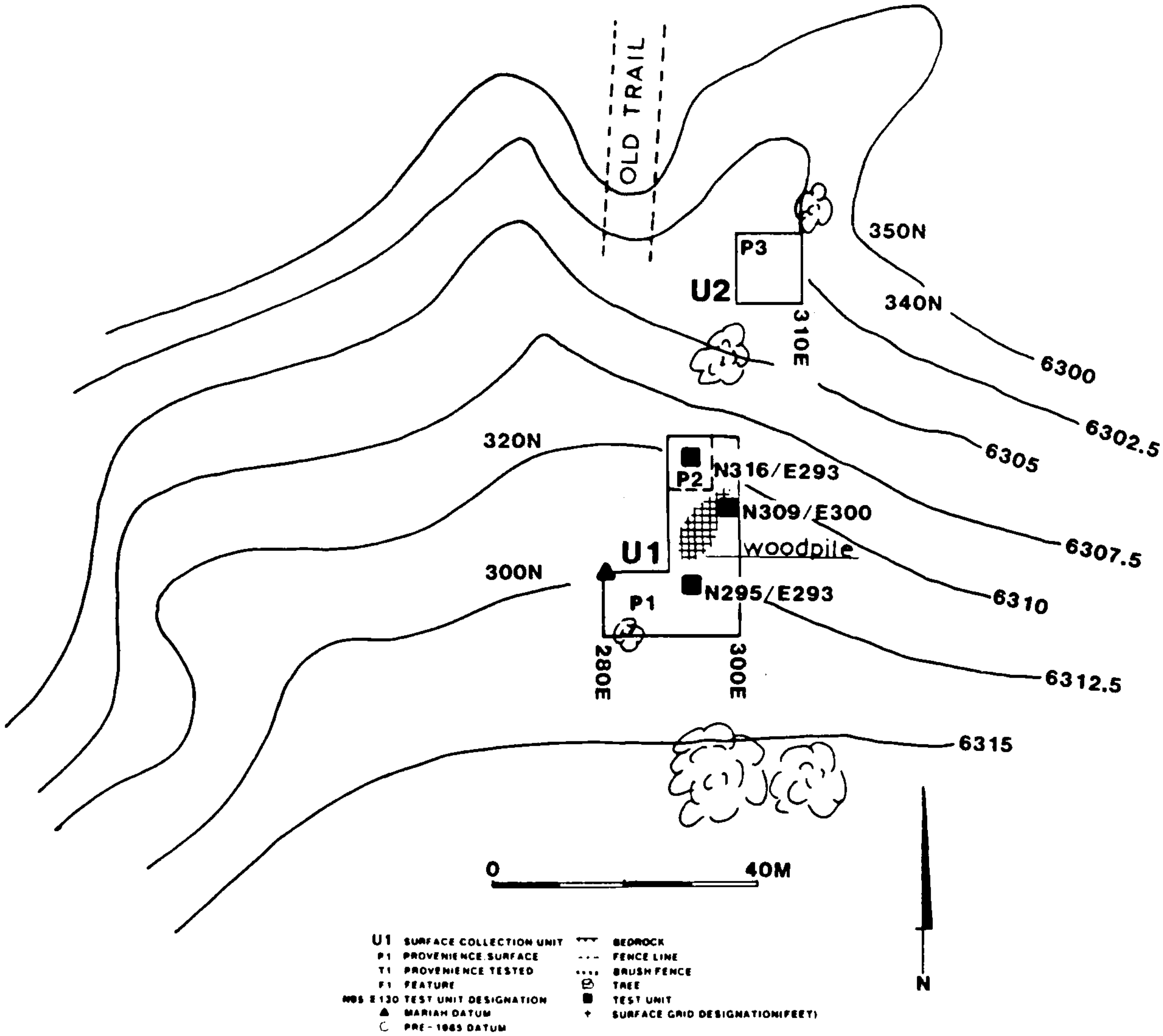
The western portion of LA 51700 includes a large area of exposed bedrock while the eastern portion is covered with light-colored, sandy soils which are well stabilized by vegetation. An intervening area is characterized by reddish soils which appear somewhat deflated. During the study a newly graded road leading to the temporary boat ramp for Abiquiu Lake was built, running south to north through the approximate center of the site, following an older, undeveloped jeep or heavy equipment trail (Figure 6.55). A permanent site stake was established on the west side of the site at grid designation 300N/270E.

6.14.2 Field Methods

LA 51700 was discovered by John Schelberg, ACOE Archaeologist, while surveying the path of the boat ramp access road. The site consists of a large, sparse scatter of lithics with occasional ceramic artifacts. No hearths or architectural features are observable on the surface. Artifactual materials are most evident in areas of exposed bedrock or reddish soils in the western half of the site, but scattered surface materials are in evidence over an extensive area in the stabilized, vegetated areas to the east. It appeared during initial inspection of the site that the light-colored, sandy fill might represent a recent, windblown deposit overlying the artifact-bearing land surface, possibly from an apparent old field, lying just to the east.

Due to limited field time and the nature of expected impacts, collection and testing strategies at LA 51700 were different from those used at previously recorded sites. Surface collection was employed primarily as a means of salvaging data from deposits to be directly impacted by road grading. Surface collection was thus largely limited to portions of the site within the road right-of-way; collection was intentionally confined to areas with appreciable soil cover. Subsurface testing was intended to check for buried archaeologi-

Figure 6.55 LA 51700, Abiquiu Archaeological Study, ACOE, 1989.



cal features or horizons which might be impacted by road construction, and test units were placed only within or immediately adjacent to the right-of-way.

6.14.3 Collection Units

In all, 500 m^2 of the site were subjected to intensive surface collection. The surface collection units included an "L"-shaped block (collection Unit 1) comprising 400 m^2 to the south, and a 10 x 10 m block (collection Unit 2) located farther north. The southern and eastern sections of the larger block were covered with stabilized soils while the remainder of this block, and the entirety of the smaller one to the north, lay within areas of reddish soil.

Surface densities in the larger, "L"-shaped collection unit varied from zero to 21 artifacts/m^2. The highest densities were found in the northwestern corner of the block in an area largely devoid of the yellow, sandy overburden. Most of the ceramics, as well as the two shell beads, came from this concentration, which appears to extend to the west and north beyond the collected area. Surface densities did not exceed three artifacts/m^2 in the rest of the block.

The small, 10-m^2 block to the north exhibited a much higher average overall surface density than did the area to the south (4.73 artifacts/m^2, as opposed to 0.98). This block also yielded fewer empty squares; 13 of the 1-m^2 grid units had more than 10 artifacts in them. Three of the projectile points recovered from the site also came from this surface block. These included two dart points and the small, corner-notched point fragment.

6.14.4 Subsurface Samples and Stratigraphy

All three test units were placed in or adjacent to the larger surface collection block. Samples are described in Table 6.46. Two of the units, with grid designations 295N/293E and 316N/293E, respectively, were located in areas of relatively high surface density (four artifacts/m^2 and 14 artifacts/m^2, respectively). The third unit, 309N/300E, was located in an area of very low surface density, to evaluate the possibility that the low surface density was the result of semistabilized, aeolian sands obscuring the deflated, artifact-bearing land surface.

Table 6.46 LA 51700 Samples, Abiquiu Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
N295/E293, Level 1	1	1	--
N309/E300, Level 2	1	1	--
N316/E293, Level 1	1	1	--

Of the three test units excavated, only one (316N/293E) yielded significant numbers of subsurface artifacts. Fill from this unit was screened through 1/8-inch hardware cloth, and several very small pressure flakes were recovered, along with other lithics and ceramics, from the first two levels (Figure 6.56). Unit 295N/293E yielded two flakes from the first level while the third test pit (309N/300E) (Figure 6.57) was completely sterile. Material from both units was screened through 1/4-inch mesh. Bedrock was encountered at depths of approximately 30, 10, and 15 cm below surface, respectively, in the three units. No evidence of a distinct, artifact-bearing horizon or surface was noted in any of the test units.

The results of test units and surface collection indicate that the actual distribution of cultural materials corresponds fairly well with the surface distributions. The significant drop-off in densities to the east of the sampled area does not appear to be the result of aeolian sands covering a culture-bearing surface or stratum. A highly diffuse scatter is, however, apparent to the east and south of the area collected. Most of the cultural materials at the site seem to be concentrated to the west and north of the areas sampled, particularly in the more eroded portions of the main concentrations as there were no projected impacts, and hence no testing in this area; the scatter probably extends to or beyond the bluff. It is not known whether there is continuity between the high density areas in the northern part of the larger surface collection block and the smaller, northern block. Differences in the artifactual contents of these two concentrations suggest that they could represent parts of temporally distinct components, but the occupations might well overlap. A strong break in slope to the north of the smaller collection block marks a convenient boundary between LA 51700 and the two sites farther northwest.

6.14.5 Chronology

A total of approximately 874 lithic artifacts and 20 ceramic sherds was recovered during the surface collection at LA 51700. Two flat, discoidal shell beads were also collected from the surface. An additional 54 lithic artifacts were collected from the excavation units. Temporally diagnostic artifacts are briefly discussed below.

Five projectile points or fragments were recovered from LA 51700. One, manufactured of obsidian, is consistent with the En Medio point type, as described by Irwin-Williams (1973). Two other large, dart point sized specimens, a straight stem and a blade fragment, are also manufactured of obsidian. A single large, corner-notched dart point is made of heat treated, white chert. The final specimen is a basal fragment of a small, corner-notched arrow point, manufactured of obsidian.

The small sample of ceramics included Ocate-like (Chacon) micaceous wares (Gunnerson 1969), an unidentified, possibly Santa Fe Black-on-white (Mera 1935) sherd, and Pueblo IV corrugated culinary ware. While the black-on-white and the culinary wares are contemporaneous dating to the fifteenth century, the Ocate-like wares represent a later nineteenth century historic

Figure 6.56 LA 51700, N316/E293, South Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

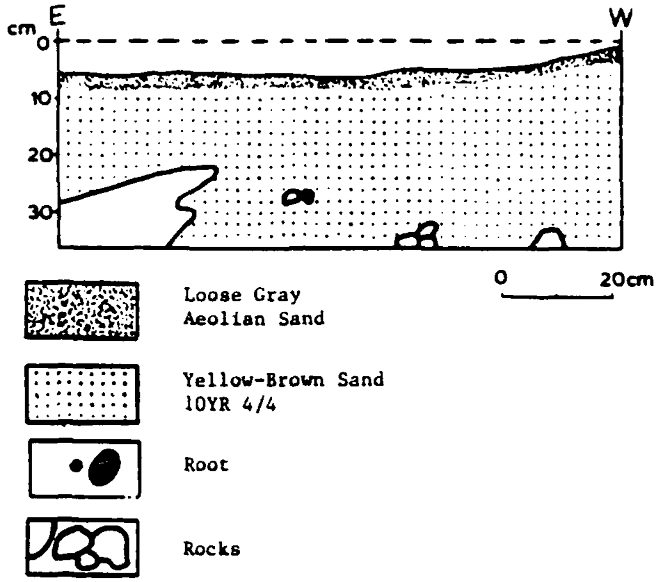
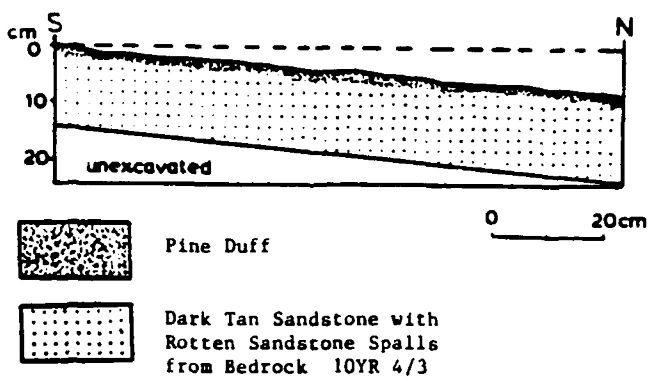


Figure 6.57 LA 51700, N309/E300, Level 2, West Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



occupation and may be the product of either Jicarilla Apaches or Indo-Hispanics from Abiquiu (see Chapter 11).

6.14.6 Rough Sort and Detailed Lithic Analysis

LA 51700 consisted of a large scatter of lithics with occasional ceramics intermixed. No hearths or architectural features were identified. The collection strategy employed on this site was aimed toward collecting artifactual materials from areas that would be directly impacted by road grading.

Five hundred m^2 of the site were subjected to intensive surface collections. The surface collection units included an "L"-shaped block consisting of 400 m^2 to the south (Unit 1) and a 10 x 10 m block to the north (Unit 2).

Four proveniences were identified on LA 51700. The distribution of surface artifacts in Unit 1 isolated two proveniences: Provenience 2 represented a general concentration measuring 5 x 6 m in 315-319N/289-295F; Provenience 1 consisted of the rest of Unit 1. Provenience 3 represented the entire surface collection recovered from Unit 2, and Provenience 4 was a subsurface test in the lithic concentration (Provenience 2). A single artifact was recovered outside of the collection units and was reported in association with Provenience 2.

A total of 965 chipped stone artifacts was recovered from the site. Several ceramics were also recovered and are discussed in Chapter 11. Historic and faunal remains were not identified. The chipped stone artifacts included 948 flakes and pieces of small angular debris, eight bifaces, five projectile points, one drill, and one core. Two items were misclassified.

A detailed sample was selected from Units 1 and 2. These samples were selected on the basis of field distribution maps and included 272 chipped stone artifacts. Fifteen were recovered from Provenience 1, and 118 were examined in Provenience 2. The rough sort data for each provenience are discussed below. Additional data provided by the detailed analysis are included when applicable.

Pedernal chert was the only material that underwent heat treatment. Sixty-nine percent of the Pedernal assemblage was heat treated while 31 percent lacked evidence of treatment. The percentage of heat treatment is slightly lower than at many other sites in the study area. When successful versus unsuccessful heat treatment was examined, 78 percent of the Pedernal chert exhibited successful treatment (350 artifacts). Twenty-two percent exhibited unsuccessful heat treatment (100 artifacts).

This assemblage exhibited high percentages of heat treatment among formal tool debitage as well as core reduction debitage (Table 6.47).

Table 6.47 LA 51700 Heat Treatment for Chert to Artifact Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total / Treated	Successful	Unsuccessful	Successful Core	Total / Successful	Total
Biface Flake	14	52	47	1	4	51	66
Biface	1	3	3	--	--	3	4
Multiplatform Core	--	1	1	--	--	1	1
Core Flake	49	180	124	54	2	126	229
Heat Spall	--	2	--	2	--	--	2
Pressure Flake	1	1	--	--	1	1	2
Projectile Point	--	1	1	--	--	1	1
Small Angular Debris	4	21	11	10	--	11	25
Unidentified Flake	130	186	130	33	23	153	316
Unifacially Retouched Flake	1	3	3	--	--	3	4
Total	200	450	320	100	30	350	650

6.14.6.1 Unit 1, Provenience 2

Provenience 2 represented the lithic concentration in Unit 1. Chipped stone artifacts recovered from this area totaled 205 and included 202 flakes and pieces of small angular debris, and one biface. Two items were misclassified.

Pedernal chert made up 91 percent (186 artifacts) of the assemblage, Polvadera obsidian comprised only five percent (10 artifacts), and the remaining four percent represented five material classes. All materials were locally available.

The Pedernal chert assemblage recovered from this area of the site appeared to represent secondary reduction and tertiary formal tool manufacture or resharpening.

Only 10 Polvadera obsidian flakes were recovered from this area. All lacked cortex, and both flakes with platforms (100 percent) were retouched suggesting formal tool manufacture or resharpening. There was no evidence of use or preparation.

One bifacial tool was recovered from this area. It was manufactured from successfully treated Pedernal chert and represented a completed portion of a cutting tool. This artifact supported other evidence that formal tool use occurred at the location. A basally snapped fragment of a Polvadera obsidian projectile point was recovered outside of Unit 1 but near Provenience 2. It was located in 32.60N/290.61E. This type of basal snap is typically caused from impact and may indicate that the artifact was removed from its haft at

the site. This projectile point fragment represented a lanceolate/palmate dart.

No expedient flake tools or marginally retouched artifacts were recovered, supporting other findings indicating that formal tools were manufactured, resharpened, and utilized in the area. Although ground stone was not recovered from this location, a single flake exhibited dorsal battering typical of ground stone sharpening.

6.14.6.2 Unit 1, Provenience 1

Provenience 1 represented the surface collection in Unit 1 that was not included in the concentration (Provenience 2). A total of 167 chipped stone artifacts was recovered from this provenience. These artifacts included 162 flakes and pieces of small angular debris, three bifaces, one projectile point, and one core.

Pedernal chert comprised the majority of the assemblage (83 percent, 139 artifacts). Polvadera obsidian made up 11 percent, and the remaining six percent represented five local material classes.

A single multiplatform core was recovered from Provenience 1. It was manufactured from successfully treated Pedernal chert and represented a random technique of core reduction.

Although the Polvadera obsidian sample was small, the assemblage indicated secondary reduction. Minimal evidence of primary decortication was indicated, and no evidence of formal tool manufacture was found.

Four formal tools were recovered from Provenience 1. These included one early biface, one projectile point, and two artifacts with extensive marginal retouch (Appendix F). Three artifacts were manufactured from obsidian (two Jemez and one Polvadera) and one from nonheat treated Pedernal chert.

One additional marginally retouched tool was recovered. It exhibited unidirectional retouch characteristic of scraping tools and was manufactured from Pedernal chert. The presence of one flake with bidirectional use wear provided evidence of expedient tool use as well as cutting activities.

The assemblage recovered from Provenience 1 was similar to that identified in Provenience 2. Both assemblages indicated formal tool manufacturing, resharpening, and use.

6.14.6.3 Unit 2, Provenience 3

Provenience 3 represented the surface distribution recovered from Unit 2. A total of 532 chipped stone artifacts was recovered from this area. These included 524 flakes and pieces of small angular debris, four bifaces, three projectile points, and one drill.

The material variability in this provenience was clearly different from that identified in Unit 1. Although Pedernal chert made up the majority of

this assemblage (52 percent, 275 artifacts). Polvadera obsidian represented 44 percent of the assemblage (235 artifacts). The remaining four percent represented five material classes. Three of these flakes were manufactured from vitrophyre that occurred in the San Antonio Mountains.

The formal tools recovered from this area supported other data indicating that formal tools were manufactured, resharpened, and used at the site. Eight formal tools were recovered. They included one blank, two early bifaces, one bifacial tool, one drill, and three projectile points. Five artifacts were manufactured from Polvadera obsidian and three from Pedernal chert. All Pedernal chert exhibited successful heat treatment.

Seven artifacts exhibited marginal retouch indicating the use of both cutting and scraping tools. These tools were manufactured from Pedernal chert (one bidirectional and two unidirectional) and Polvadera obsidian (four unidirectional). Expedient flake tool utilization was indicated by two flakes with unidirectional wear and one flake with and bidirectional wear. These data further indicate that this provenience represented a use activity area as well as a manufacturing location.

6.14.6.4 Provenience 4

Provenience 4 was a subsurface test in the surface concentration (Provenience 2). Sixty-one artifacts were recovered from this test pit. These included 59 flakes and two pieces of small angular debris. The overall assemblage represented similar reduction to the assemblage identified on the surface of this area; however, the proportion of materials represented was clearly different. Pedernal chert made up 82 percent of this assemblage while it represented only 52 percent of the surface distribution.

The assemblage was not similar to Provenience 2 when tool utilization was examined. No evidence of remnant use, indicative of resharpening, was identified in this area. In addition there were no formal or expedient tools recovered. The lack of evidence of tool utilization in addition to the variability in materials represented suggested that the subsurface assemblage was not part of the surface activity area and probably represented a separate manufacturing assemblage.

6.14.6.5 Lithic Summary and Site Activity Areas

The assemblage recovered from LA 51700 represented a tool manufacturing and utilization area. The surface assemblages indicated a variety of use activities which include formal as well as expedient tool use. Use activities represented included cutting, scraping, drilling, and grinding. Although no hearth features were identified, the percentage of unsuccessfully heat treated materials in conjunction with the variety of use activities suggested that a hearth feature did exist.

The assemblage recovered from the test pit in Provenience 2 indicated that the surface assemblage was not representative of buried deposits. The subsurface materials clearly lacked evidence of use activities.

6.14.7 Summary

Site LA 51700 consisted of a diffuse scatter of lithic artifacts with some sherds. Most of the artifactual material was present in eroded or deflated soil and bedrock areas in the western and northern portions of the site. Two temporally and perhaps spatially distinct components appeared to be present. Clear boundaries were difficult to establish, as the area sampled was surrounded by a very low density scatter of considerable extent. Further details on chronology are presented in Chapters 7 and 8.

6.14.8 Recommendations

The site extent and its relationship to LA 51701, LA 51702, and LA 51703 should be addressed through mapping and collection.

6.15 LA 51701

6.15.1 Physiographic Setting

Site LA 51701 is situated on a small, level area or bench on the same low ridge as LA 51700. The portions of LA 51701 which were sampled are located approximately 150 m south of LA 51700. The soil cover at LA 51701 is extremely rocky and appears to be relatively thin, although no subsurface testing was conducted. The site area slopes from south to north, and significant breaks in slope are present within 20 m of the collected areas in both these directions. Two small drainages cross the slope between the two surface collection units, uniting just to the north, while a third small drainage is present immediately to the west. The new Abiquiu Lake boat ramp access road passes directly through both collection units, following the path of an older jeep or heavy equipment trail. The site lies at elevations between approximately 6255 and 6275 feet.

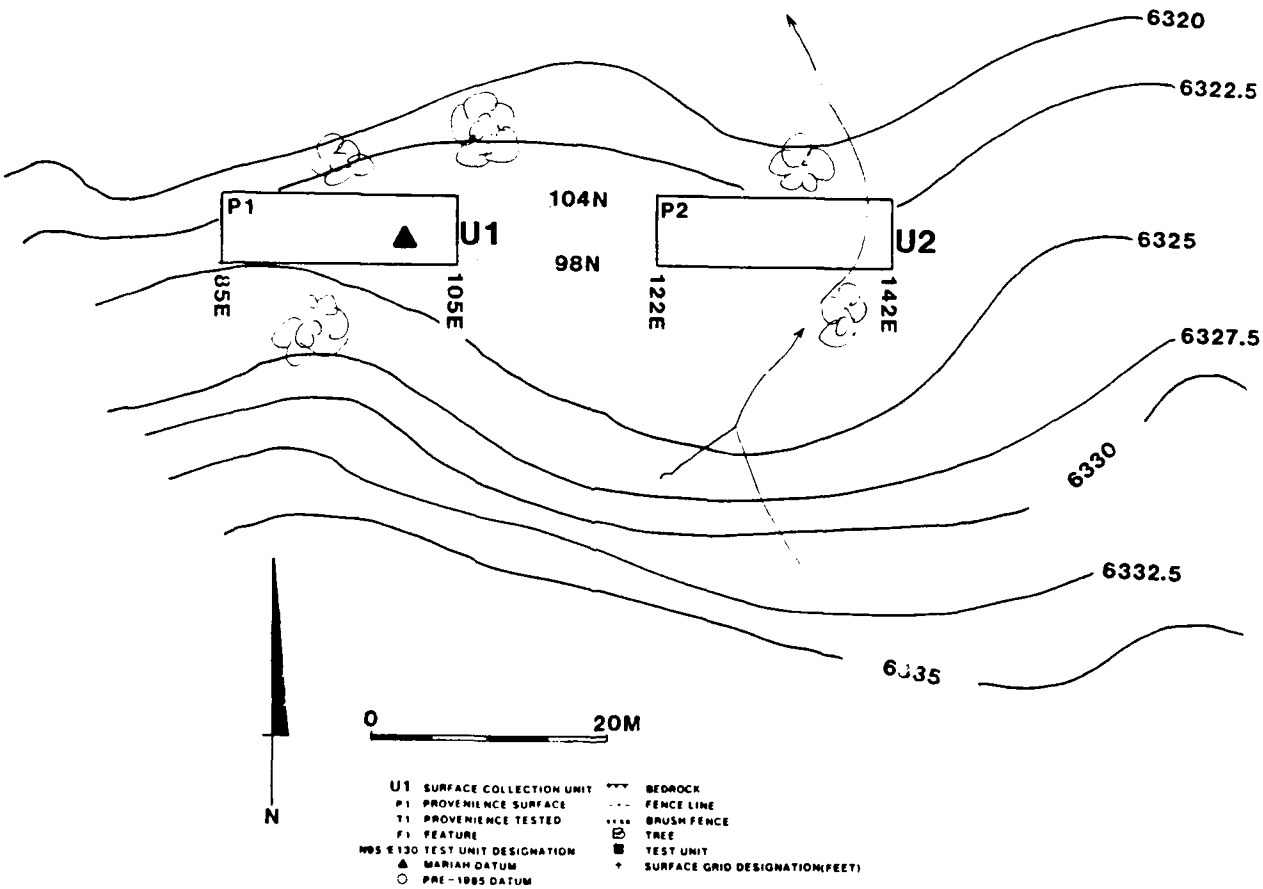
Outcrops of gravels containing chert and quartzite cobbles occur within 100 m of LA 51701, upslope to the southeast. Pebbles of these materials were observed in the soils within and around the areas surface collected.

6.15.2 Field Methods

LA 51701 was located by John Schelberg, ACOE Archaeologist, in the course of surveying the right-of-way for the boat ramp access road. Cultural materials are sparse in this location and are difficult to discern from local gravels. As a result the area was not identified as an archaeological location until road construction was already under way. At that time the site appeared to represent a small, highly diffuse lithic scatter.

Investigation of LA 51701 was limited to surface collection as a result of the limited field time available. A total of 240 m^2 was subject to 100 percent collection. Because projected impacts to the location were limited to road grading, collection was largely confined to the area of the proposed right-of-way. Two rectangular blocks (collection Units 1 and 2), aligned east-west, were established directly within the route of the boat ramp access road (Figure 6.58).

Figure 6.58 LA 51701, Abiquiu Archaeological Study, ACOE, 1989.



6.15.3 Collection Units

A total of 218 lithic specimens was collected from the surface. These included one projectile point; a single fragment of a small black-on-white ceramic jar, which is likely Kwahe'e Black-on-white (Kidder 1936) or Gallina Black-on-white; and one piece of ground stone. Surface densities averaged one artifact/m^2 and ranged from zero to eight. These density figures are not comparable to those given for other sites. No clearly definable concentrations or sharp discontinuities appear to have existed, although densities were somewhat higher in the westernmost collection block.

The single projectile point collected at LA 51701 is a small, straight-based, side-notched arrow point of an undefined Puebloan period.

The bulk of the materials collected from LA 51701 consisted of unretouched flakes, chunks, and broken pebbles of chert and chalcedony. Although a number of these were of indisputable human manufacture, many may not be. Naturally occurring pebbles of lithic materials commonly used in the Abiquiu area outcropped to the south of LA 51701 and were also found in the soil at the site, probably washed down from the exposures higher uphill. During collection procedures it was noted that many broken cobbles and angular pieces were imbedded within the ruts of the jeep trail which formerly ran through the collection units. It is likely that a significant proportion of the lithic materials collected from LA 51701 represents the remains of naturally occurring elements in the disturbed soil; it is difficult to assign boundaries or limits to the surface scatter. The site appeared to be a part of an extremely extensive, low density surface scatter which covers the low ridge on which LA 51701 and LA 51700 are located. It is not impossible that LA 51701 is continuous with the low density scatter extending south of LA 51700. These continuous low density scatters may be associated with the outcropping of raw material in cobble beds in the area.

6.15.4 Rough Sort Lithic Analysis

LA 51701 was a sparse lithic scatter situated on a gravelly bench. A total of 240 m^2 of the site was subject to intensive surface collection. The surface collection units consisted of two rectangular blocks. No subsurface testing was carried out at LA 51701. Since no distinctive surface clusters or concentrations could be recognized, the site was divided into two provenience units, each of which corresponded to one of these surface collection blocks.

A total of 200 lithic artifacts from LA 51701 was analyzed. These artifacts included 176 flakes, 18 pieces of angular debris, two cores, one biface, one projectile point, and two artifacts of questionable cultural origin (classed as miscellaneous) (Table 6.48). A ground stone fragment and a single ceramic sherd were also collected. Approximately 83 percent of these artifacts were manufactured of Pedernal chert. A surprisingly wide variety of other materials is represented in smaller quantities, including Polvadera and Jemez obsidian and several types of chert which are probably available in local gravels. The "Varia" category in Table 6.49 is composed primarily of

Table 6.48 LA 51701 Provenience Summary by Artifact Type, Abiquiu Archaeological Study, ACOE, 1989.

Prove-nience	Biface #	Biface %	Core #	Core %	Flake #	Flake %	Large Angular Debris #	Large Angular Debris %	Miscel-laneous #	Miscel-laneous %	Projec-tile Point #	Projec-tile Point %	Small Angular Debris #	Small Angular Debris %	Total #	Total %
1	1	1	1	1	116	91	--	--	--	--	--	--	9	7	127	
2	--	--	1	1	60	83	2	3	2	3	1	1	7	9	73	
Total	1	<1	2	1	176	88	2	1	2	1	1	<1	16	8	200	

Table 6.49 LA 51701 Provenience Summary by Material Type, Abiquiu Archaeological Study, ACOE, 1989.

Prove-nience	Varia #	Varia %	Brown Jasper #	Brown Jasper %	Jemez Obsidian #	Jemez Obsidian %	Moss Jasper #	Moss Jasper %	Nacimiento Chert #	Nacimiento Chert %	Pedernal Chert #	Pedernal Chert %	Polvadera Obsidian #	Polvadera Obsidian %	Quartzite #	Quartzite %	Total
1	13	10	7	6	1	1	1	1	1	1	103	81	--	--	1	1	127
2	--	--	--	--	3	4	--	--	--	--	63	87	7	10	--	--	73
Total	13	7	7	4	4	2	1	<1	1	<1	166	82	7	4	1	<1	200

basalts, with a few artifacts of dubious raw material attribution. The greatest variety of materials is present in Provenience 1.

Heat treatment at LA 51701 is confined largely to Pedernal chert, with the exception of three unknown chert artifacts in the "Miscellaneous" category (Table 6.50). Only 17 percent of the artifacts of this material exhibit successful heat treatment; an additional 11 percent appear to have been unsuccessfully treated or burned. The few artifacts identified as biface flakes actually show a lower proportion of heat treatment than those flakes in the "Core" or "Unidentified" category (Table 6.51).

Table 6.50 LA 51701 Heat Treatment by Material Type for Entire Site, Abiquiu Archaeological Study, ACOE, 1989.

	Unknown	None	Total # Treated	Unsuccessful	Successful Flake	Total
Miscellaneous	--	10	3	1	2	13
Brown Jasper	1	6	--	--	--	7
Jemez Obsidian	--	4	--	--	--	4
Moss Jasper	--	1	--	--	--	1
Nacimiento Chert	--	1	--	--	--	1
Pedernal Chert	--	118	48	20	28	166
Polvadera Obsidian	--	7	--	--	--	7
Quartzite	--	1	--	--	--	1
Total	1	148	51	21	30	200

6.15.4.1 Provenience 1

Provenience 1 yielded a total of 127 artifacts, including 116 flakes, a biface fragment, one core, and nine pieces of angular debris. Pedernal chert is the only material present in significant quantities (81 percent) although a variety of other materials is present in small quantities (Table 6.52).

Approximately 15 percent of the chert artifacts from this provenience exhibited dorsal cortex, including approximately nine percent with more than 50 percent dorsal cortex coverage. Approximately 72 percent of flakes with platforms had faceted platforms. The next most common platform type was retouched (14 percent) followed by cortical (11 percent) and collapsed (three percent) platforms. None of the platforms observed showed evidence of preparation or use. The core collected from this provenience was a tested core, a piece of untreated Pedernal chert with a few flakes removed, possibly rejected for raw material flaws, dominated by cortical platforms (58 percent).

Table 6.51 LA 51701 Heat Treatment by Artifact Type for Entire Site, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total # Treated	Success-ful	Unsuc-cessful	Total
Biface Flake	8	1	1	--	9
Biface	--	1	1	--	1
Tested Core	2	--	--	--	2
Core Flake	75	34	21	13	109
Heat Spall	--	1	--	1	1
Large Angular Debris	--	2	1	1	2
Projectile Point	--	1	1	--	1
Retouched Artifact	--	1	1	--	1
Small Angular Debris	11	3	1	2	14
Unidentified Flake	21	5	2	3	26
Total	117	49	29	20	166

Table 6.52 LA 51701 Artifact Group by Material Type, Provenience 1 (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type				
Material Type	Biface	Core	Flake	Small Angular Debris	Total
Varia	--(--)	--(--)	11(85)	2(15)	13
Brown Jasper	--(--)	--(--)	7(100)	--(--)	7
Jemez Obsidian	--(--)	--(--)	1(100)	--(--)	1
Moss Jasper	--(--)	--(--)	1(100)	--(--)	1
Nacimiento Chert	--(--)	--(--)	1(100)	--(--)	1
Pedernal Chert	1(1)	1(1)	94(91)	7(7)	103
Quartzite	--(--)	--(--)	1(100)	--(--)	1
Total	1(1)	1(1)	116(91)	9(7)	127

No marginally retouched or utilized flakes were collected from Provenience 1. A single fragment of a completed biface, manufactured of heat treated Pedernal chert, was collected.

The small assemblage from Provenience 1 appears to be primarily attributable to core reduction. The relatively high frequency of cortex, cortical platforms, and angular debris, along with the presence of a tested core, indicates an unusually strong primary reduction component. A minor biface reduction component is also indicated by the presence of a biface and several flakes with retouched platforms. No other material is present in sufficient quantities to support reliable inferences about the lithic manufacture activities represented, although the unusually high percentage of cortical platforms in the basalt artifacts in the "Varia" category is noteworthy and probably represents early stage core reduction as well.

6.15.4.2 Provenience 2

A total of 73 lithic artifacts was collected from Provenience 2, including 60 flakes, nine pieces of angular debris, one core, one projectile point, and two artifacts of dubious cultural origin (Table 6.53). A fragment of a quartzite metate and a single black-on-white sherd were also collected from this provenience. Pedernal chert is again the predominant material (86 percent). Seven flakes of Polvadera obsidian and three of Jemez obsidian were also collected.

Table 6.53 LA 51701 Artifact Group by Material Type, Provenience 2 (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type						
Material Type	Core	Flake	Large Angular Debris	Miscellaneous	Projectile Point	Small Angular Debris	Total
Jemez Obsidian	--(--)	3(100)	--(--)	--(--)	--(--)	--(--)	3
Pedernal Chert	1(1)	50(81)	2(3)	2(3)	1(1)	7(11)	63
Polvadera Obsidian	--(--)	7(100)	--(--)	--(--)	--(--)	--(--)	7
Total	1(1)	60(83)	2(3)	2(3)	1(1)	7(10)	73

Cortex is present on approximately 52 percent of all Pedernal chert artifacts, and almost 10 percent have more than half of the dorsal surface covered with cortex. Faceted platforms are the most frequent type encountered (44 percent of flakes with platforms), followed by cortical (16 percent), collapsed (16 percent), and retouched (five percent) platforms. None exhibits any signs of prior use or preparation. The single core collected is a tested chunk of untreated chert.

No casually retouched or utilized unretouched flakes were collected from Provenience 2. A single, complete, side-notched arrow point manufactured of heat treated Pedernal chert was recovered.

The small assemblage from Provenience 2 is heavily dominated by core reduction debris. The unusually high frequencies of cortex and cortical platforms indicate a considerable amount of primary reduction at this location. Biface manufacture is represented by a very small proportion of this assemblage.

6.15.4.3 Summary and Discussion of Site Formation Processes

Proveniences 1 and 2 at LA 51701 are similar in that both are dominated by core reduction debris and both contain a relatively high proportion of cortex and cortical platforms, indicative of the earliest stages of core reduction. During fieldwork it was noted that deposits of gravels containing Pedernal chert and a variety of other lithic materials were located a short distance uphill from LA 51701. The proximity of the materials and the particular mix of lithic debris present at the two site proveniences suggest that the area was used primarily for the initial testing and reduction of raw materials. Additional, more complex manufacturing activities, some involving obsidian and heat treated cherts, indicate a limited variety of other manufacturing activities were carried out in this area.

In spite of the two proveniences' proximity and overall similarity, however, there are some differences. For example, Provenience 1 exhibits a larger proportion of debris attributable to biface manufacture. Provenience 1 also has a greater variety of materials than Provenience 2. The differences between Proveniences 1 and 2 are probably attributable to a more or less random spacing of short-term reduction or manufacture events in the area.

An unimproved dirt road originally ran through the center of the surface collected portion of LA 51701, and it was suggested that many of the apparent artifacts present on the site represented locally occurring chert gravels fractured by vehicular traffic. The high proportion of angular debris on this location (eight percent of all artifacts) may reflect this process. The presence of numerous flakes with platforms, however, indicates that there is a significant, probably predominant, prehistoric behavioral component to the assemblage.

6.15.5 Summary

A total of 240 m^2 of LA 51701 was subject to intensive surface collection, resulting in the recovery of approximately 218 lithic specimens, including a single projectile point, as well as one ceramic sherd. The lithic assemblage reflects both prehistoric behavior and vehicular traffic.

6.16 LA 51702

6.16.1 Physiographic Setting

This diffuse lithic scatter is located in an area which generally dips west to the Rio Chama. The site is situated at an elevation of 6240 feet, approximately 850 m southeast of the Rio Chama.

The topography of the area is characterized by numerous east-west trending ridges interspersed with shallow to entrenched intermittent drainages which exhibit large, sloping areas of exposed sandstone bedrock. When sediments are present, they consist of shallow sands and loams. East of the area are vertical sandstone escarpments. The scatters were located on sandstone bedrock or slickrock areas overlain with a thin veneer of small to medium-sized lag gravels.

6.16.2 Field Methods

This site was a portion of a large artifact scatter on the east slope of the Rio Chama. This site had not been previously reported and was to be directly impacted by boat ramp construction. Artifacts were located in two distinct concentrations on the south slope of a low, east-west trending ridge. Both concentrations occurred on bedrock and appeared to have resulted from downslope erosion. The concentrations were located in a general, diffuse scatter of lithic and historic artifacts; all artifacts in the impacted area were located on bedrock deposits.

6.16.3 Collection Units

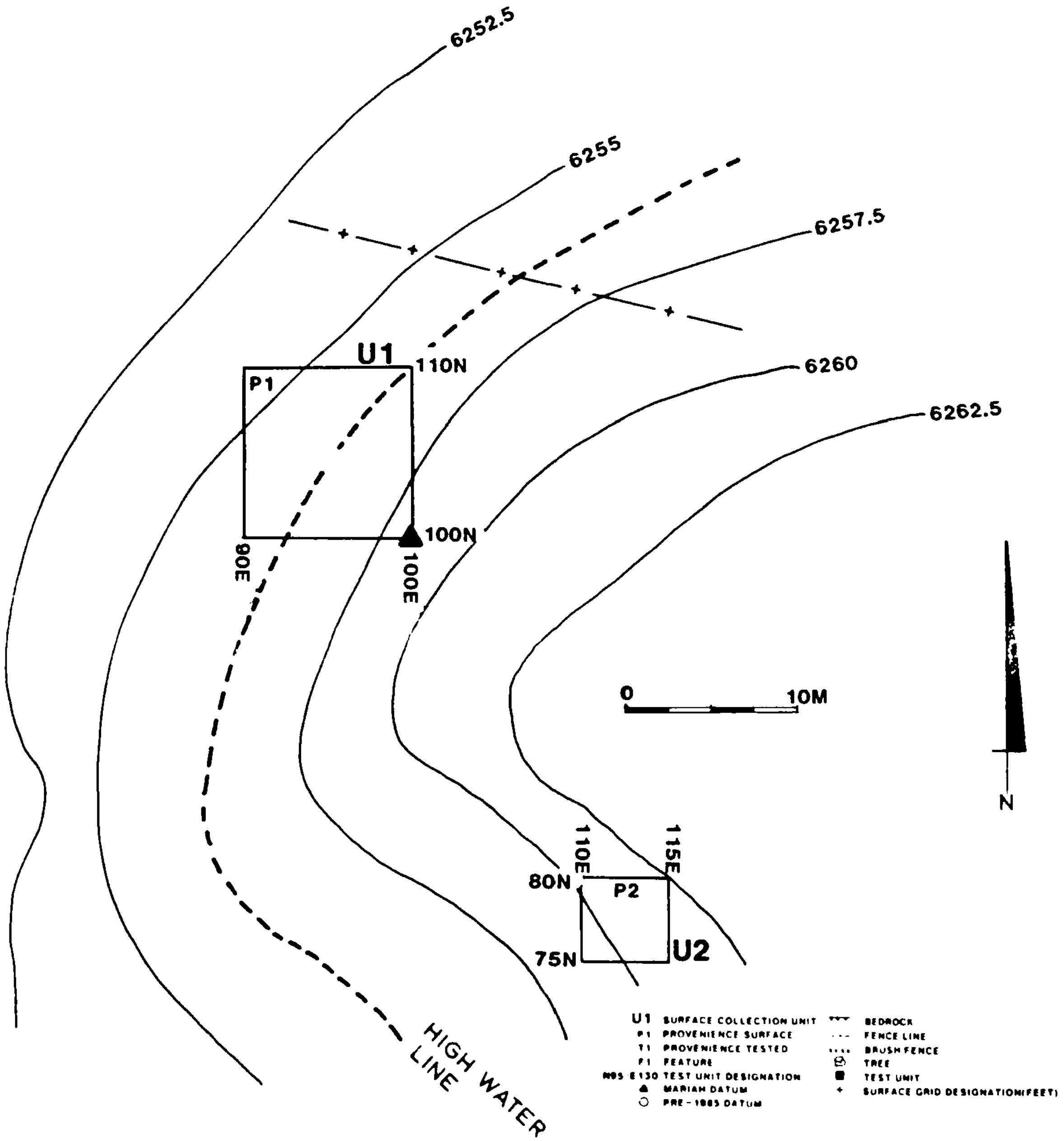
Two surface collection units were located over the two artifact concentrations to be directly impacted (Figure 6.59). Collection area 1 was located at the water's edge and consisted of a 10 x 10 m area. Area 2 was located 22 m southeast and upslope from area 1 and consisted of a 5 x 5 m collection unit. Owing to the presence of artifacts directly on bedrock exposures in the site area, no subsurface testing was conducted.

Four hundred and fifty-five lithic artifacts were recovered from the surface of LA 51702. These did not include any temporally diagnostic artifacts nor any readily apparent retouched artifacts. Three hundred and thirteen of these were located in collection Unit 1 where the surface density had a maximum of 21 items/m^2. One hundred and forty-two lithic artifacts were present in collection Unit 2. The maximum artifact density in this unit was 20 items/m^2. A bottle dating to the turn of the century was collected north of collection Unit 2.

6.16.4 Rough Sort Lithic Analysis

LA 51702 was represented by a lithic scatter that was defined during the field phase as two distinct concentrations. Both concentrations appeared to have been eroded. Surface collection units were placed over these concentrations. Collection Unit 1 was located in the northern portion of the site and consisted of a 10 x 10 m area. Collection Unit 2 was located 22 m southeast

Figure 6.59 LA 51702, Abiquiu Archaeological Study, ACOE, 1989.



of Unit 1 and consisted of a 5 x 5 m collection unit. The distribution of surface artifacts and the distribution of various material types were examined within these units to determine if additional horizontal proveniences could be identified. In this case no additional horizontal proveniences were isolated. Because artifact distributions lay on bedrock, no subsurface tests were excavated.

A total of 454 artifacts was recovered from the site. Ceramic, faunal, and ground stone artifacts were not present. The bottle mentioned above was the only historic artifact recorded. Ninety-seven percent of the chipped stone assemblage was flakes and small angular debris (442 debitage items). Other artifacts (three bifaces, three cores, and six pieces of large angular debris) made up three percent of the chipped stone assemblage. The entire assemblage of lithic artifacts underwent the rough sort. No detailed sample was examined on the site.

Table 6.54 describes overall material selection on the site. Ninety-eight percent of the materials on the site were manufactured from Pedernal chert (445 artifacts). Nine additional artifacts represented six local material categories. Unlike other assemblages from the study area, obsidian comprised an extremely small proportion of the assemblage (three artifacts, one percent). Jemez obsidian was totally lacking.

Table 6.54 LA 51702 Artifact Type to Material Type Frequencies (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type					
Material Type	Biface	Core	Flake	Large Angular Debris	Small Angular Debris	Total
Miscellaneous	--(--)	--(--)	1(100)	--(--)	--(--)	1
Brown Jasper	--(--)	--(--)	1(100)	--(--)	--(--)	1
Morrison Chert	--(--)	--(--)	1(100)	--(--)	--(--)	1
Pedernal Chert	3(1)	2(<1)	425(96)	6(1)	9(2)	445
Polvadera Obsidian	--(--)	--(--)	3(100)	--(--)	--(--)	3
Quartzitic Sandstone	--(--)	1(100)	--(--)	--(--)	--(--)	1
Quartzite	--(--)	--(--)	2(100)	--(--)	--(--)	2
Total	3(1)	3(1)	433(95)	6(1)	9(2)	454

One hundred percent of the heat treatment on this site occurred on Pedernal chert. Although other materials were low in frequency (nine artifacts), none exhibited heat treatment. Sixty-four percent (286 artifacts) of the Pedernal assemblage on LA 51702 exhibited evidence of heat treatment. Of the artifacts that exhibited heat treatment, 83 percent percent (238 arti-

facts) were successfully treated while only 17 percent (48 artifacts) exhibited morphology indicating they were unsuccessfully treated.

Table 6.55 indicates type of artifact and heat treatment. When flakes from bifaces and cores were examined, a higher percentage of biface flakes (88 percent) was treated than core flakes (60 percent). In addition, biface flakes exhibited a much higher percentage of successfully treated flakes (22, 96 percent) than core flakes (129, 80 percent). These data indicated not only that a very large proportion of bifacially manufactured tools was heat treated, but also that successfully heat treated flakes were selected for bifacial tool manufacture.

Table 6.55 LA 51702 Heat Treatment for Chert to Artifact Type Frequencies, Abiquiu Archaeological Study, ACOE, 1989.

	None	Total Treated	Successful	Unsuccessful	Total
Biface Flake	3	23	22	1	26
Biface	1	2	--	2	3
Multiplatform Core	--	1	1	--	1
Core Flake	103	161	129	32	264
Multiplatform Exhausted Core	--	1	1	--	1
Large Angular Debris	4	2	2	--	6
Small Angular Debris	3	6	3	3	9
Unidentified Flake	44	90	80	10	134
Unifacially Retouched Flake	1	--	--	--	1
Total	159	286	238	48	445

The lower percentage of core flakes that are heat treated may indicate that strategies of heat treatment were dependent upon strategies of tool manufacture. For example, cores that are used to produce flake blanks for bifacial tool manufacture may be heat treated, yet it may not be necessary to heat cores used to produce expedient flakes. Through the examination of heat treatment, it may be possible to better understand the parameters that condition a variety of tool manufacturing strategies.

Cores and core flakes indicated that a random multiplatform technique as well as bifacial core reduction technique was employed. The three cores recovered from the site included two regular multiplatform cores (Pedernal chert and quartzitic sandstone) and one exhausted multiplatform core (Pedernal chert). Both Pedernal cores exhibited successful heat treatment. Bifacial core reduction was indicated by two core flakes with bidirectionally retouched

platforms. The lack of bifacial cores was expected given the abundant evidence of bifacial tool manufacture at the site.

Formal tool manufacture was clearly indicated by flakes with retouched platforms (25, 13 percent) and biface flakes (26, six percent). Retouched platforms occurred on 15 biface flakes (60 percent), two core flakes (eight percent), and eight undetermined flakes (32 percent). The lack of uniface flakes with retouched platforms suggested that bifacial tool manufacture was emphasized. Platform preparation was identified on five flakes with faceted platforms, and use was clear on three faceted platforms suggesting that manufacture and resharpening may have occurred at the site.

An examination of artifacts with facial or extensive marginal retouch supported other findings that formal tool manufacture occurred at the site. Four artifacts (two bifaces, one uniface, and one extensive unidirectionally retouched artifact) were discarded at the site due to manufacturing error or breakage. Two biface fragments and a uniface, manufactured from Pedernal chert, were recovered from Provenience 1. The bifaces represented early stages of manufacture (type 2), and thermal surfaces indicated that one biface was manufactured from a heat treated flake. The Polvadera artifact with extensive unidirectional retouch that was recovered from Provenience 2 was also discarded prior to completion.

A minimal amount of expedient tool use was indicated by five utilized flake tools. Unidirectional wear indicative of scraping activities was identified on three Pedernal flakes and one Polvadera flake. Bidirectional wear indicating cutting activities was identified on one Pedernal flake in Provenience 2. A single Pedernal flake with dorsal battering suggests that ground stone was resharpened at the site.

Ten artifacts exhibited marginal retouch; nine were manufactured from Pedernal chert and one from quartzite. Unidirectional retouch was recorded on eight artifacts and bidirectional marginal retouch on one.

6.16.5 Site Activities

In general the characters of both proveniences are similar. Provenience 1 represents the surface collection unit in the northern portion of the site. The majority of chipped stone debris found on the site was recovered from this unit (317 artifacts, 60 percent). One hundred and thirty-seven artifacts (30 percent) were recovered from Provenience 2 located southeast of Provenience 1. Both assemblages reflect the decortication of raw materials as well as formal tool manufacture, although the bifaces that were recovered from the site were located in Provenience 1. Bifacial and random core reduction was indicated in both proveniences. Expedient tool use occurred in both locales.

The overall site assemblage indicates that site function was primarily aimed toward the reduction of raw materials and the manufacture of formal tools. Although some evidence of tool use is indicated by more expedient tools and resharpening flakes, assemblage character clearly indicates formal tool manufacture.

6.16.6 Summary

Two distinct lithic concentrations were located at this site. A surface collection at these two concentrations yielded 455 lithic artifacts. These artifacts were composed almost entirely of debitage.

6.17 LA 51703

6.17.1 Physiographic Setting

This large, multicomponent lithic/ceramic site is situated on a small, flat bench directly upslope and to the east of LA 51702. It was distinguished from LA 51702 by fall-off in artifact density and presence of temporally diagnostic artifacts. The two sites are adjacent concentrations within a much larger scatter which may be continuous with the scatter containing LA 51700 and LA 51701. The site lies approximately 850 m from the riverbed at an elevation of 6265 feet. The topography drops in elevation to the west to form a southwest-northeast trending ridge. Directly south of the site area is a vertical, sandstone outcrop. This bluff is less than 1 m high within the southern edge of the site but increases to several meters high southeast of the site area. Deposits in the area range from stable loams near the sandstone escarpment to exposed bedrock and gravel deposits in the western portion of the site. Vegetation is absent in areas of exposed gravels and bedrock, while sparse grasses are present on more stable loams.

6.17.2 Field Methods

This site was located in an approximately 60 x 50 m, planned, unimproved boat ramp parking area; it was anticipated that the area would be directly impacted by vehicular traffic. Within this area was a moderate density scatter, 35 m east-west x 45 m north-south. Moderate artifact densities continued to the north and northwest of the parking area; these were not sampled. To the west the diffuse scatter joined LA 51702, and to the south and east the scatter disappeared within the bounds of the planned parking area. No features or surface concentrations were apparent in the site area.

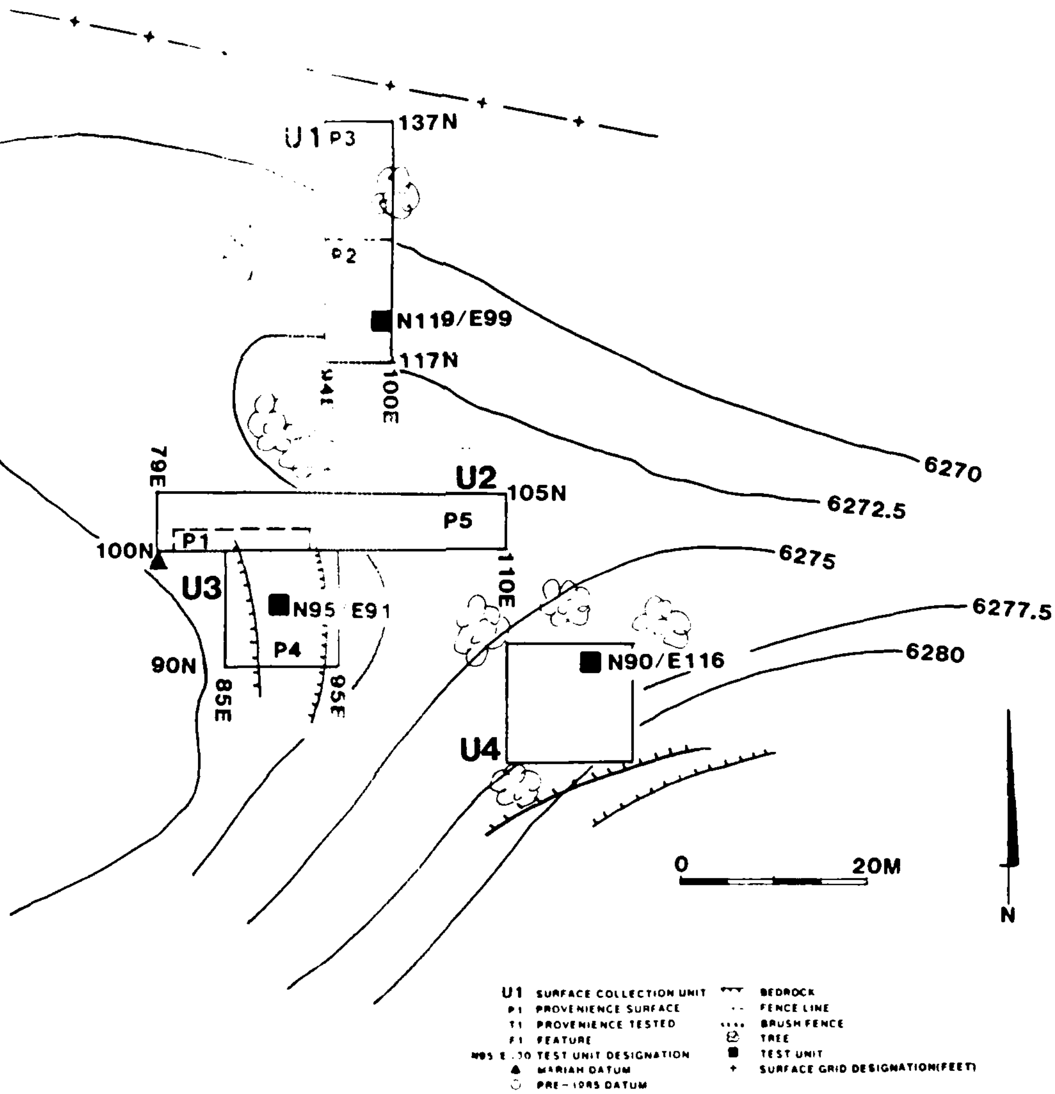
6.17.3 Collection Units

Four hundred and ten square meters, composed of four spatial units, were surface collected (Figure 6.60). Unit 1 consisted of a 20 x [illegible] m area located in the northwestern portion of the parking area. This collection unit was oriented north-south, and the majority of artifacts was located on a mostly soilless mixture of small gravels and sandstone fragments on sandstone bedrock. The southern end of the collection area contained shallow sand deposits.

Collection Unit 2 consisted of a 30 x 5 m, east-west oriented transect. This unit was located to crosscut the moderate density scatter and the more diffuse artifact scatter to the east.

Collection Unit 3 was located adjacent to and downslope from Unit 2. Unit 3 was located, as per contract, in an area of low density surface arti-

Figure 6.60 LA 51703, Abiquiu Archaeological Study, ACOE, 1989.



facts. Deposits in the area were stable sands and loams with some exposed bedrock.

Collection Unit 4 was located on the eastern edge of the parking area where only diffuse artifacts were present. This area was next to a low, vertical, sandstone outcrop and contained very stable, sandy loams, thought to extend to 30+ cm depth on the basis of pinflag probing.

One thousand four hundred and sixty-three lithic and 73 ceramic artifacts were collected from the surface of this site.

The distribution of surface materials in Unit 1 suggests two spatially discrete ceramic concentrations at the northern and southern ends of the transect. The concentrations are composed of very small sherds of Cimarron-like micaceous ware dating post A.D. 1750 (Gunnerson 1969), termed Chacon Micaceous in this report and dated to the 1830s-1870s (Chapter 11), and each concentration probably represents one vessel. A small scatter containing 11 pieces of fire-cracked rock was located roughly in the center of the transect. Lithic artifacts exhibited rather uniform moderate density with slightly higher densities co-occurring with the ceramics at the ends of the transect. At the north end of the transect, artifacts reach a maximum density of 48/m^2 and at the south end 26/m^2. A total of 785 lithic artifacts was collected from this unit.

Seven hundred and six lithic artifacts were collected in Unit 2. These included one corner-notched En Medio style projectile point manufactured from obsidian. The surface artifact density was a maximum of 28 lithics/m^2 at the western end of the transect.

One hundred and eighty-three lithic artifacts were collected from the 100-m^2 area in Unit 3. The artifact distribution in this area was uniform and had a maximum density of six artifacts/m^2. No surface artifacts were present in collection Unit 4.

6.17.4 Subsurface Samples and Stratigraphy

Three test pits were excavated in three of the four collection unit areas. All materials were screened through 1/4-inch mesh. Samples are listed in Table 6.56. In Unit 1, grid 119N/99E was excavated in the sand deposits to test for subsurface materials. This unit was located in a ceramic concentration and was excavated to a depth of 10 cm.

The sands extended only to 10 cm depth, below which bedrock sandstones were encountered (Figure 6.61). This unit yielded two lithic and two ceramic artifacts in the upper surface duff.

Test unit 95N/91E was also located in apparently stable surface loam deposits exhibiting a very low density of surface artifacts. This was located in the lower area of the site which exhibited low (<1 m) benches sided by blocky sandstone. This unit was excavated to a depth of 20 cm.

Figure 6.61 LA 51703, N119/E99, West Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

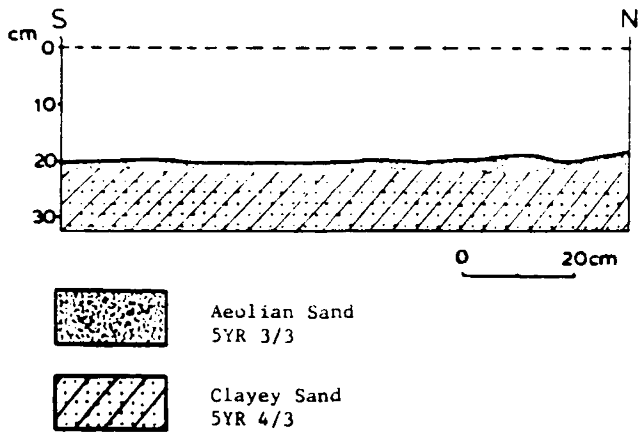


Figure 6.62 LA 51703, N95/E91, East Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

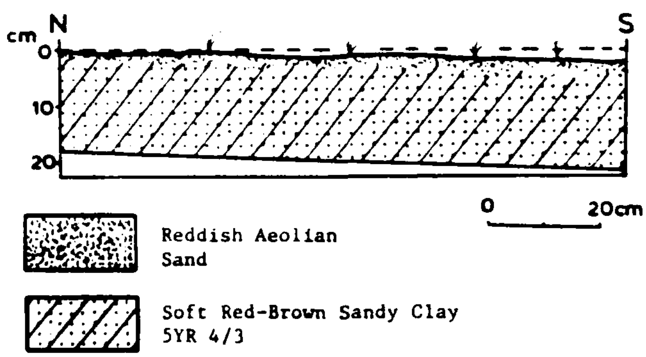


Table 6.56 LA 51703 Samples, Abiquiu Archaeological Study, ACOE, 1989.

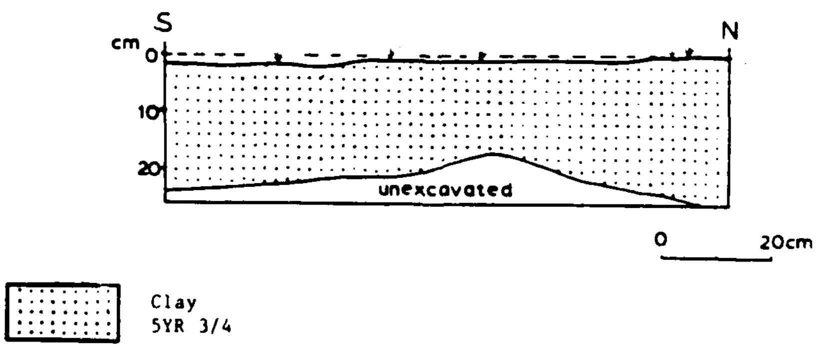
Provenience	Flotation	Pollen	C-14
N90/E116, Level 2	--	1	--
N95/E91, Level 2	1	1	--
N119/E99, Level 0-1	1	1	--

Excavation unit 95N/91E was located near the center of collection Unit 3. No subsurface cultural materials were present in this excavation unit. The upper 10-cm level contained three 10-cm, rounded cobbles in loam matrix. The second level contained sandstone spalls in a loam matrix; bedrock was encountered at the base of this level (Figure 6.62).

Test pit 90N/116E was located in the center of collection Unit 4. This pit was placed approximately 6 m south of the vertical sandstone outcrop. Deposits in this area were stable and appeared to be filling or aggrading rather than eroding. This area, therefore, seemed likely to contain buried cultural materials. This unit was excavated to a depth of 26 cm.

No subsurface artifacts were present. Numerous rounded cobbles measuring from 20 x 20 cm to 4 x 4 cm were present in a clayey matrix in the upper 10-cm level of this excavation unit. These cobbles were absent in the lower clayey matrix which continued for another 10 to 15 cm (Figure 6.63). At that level a soft, brownish-green, basal shale was present and excavations ceased.

Figure 6.63 LA 51703, N90/E116, West Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.



6.17.5 Rough Sort and Detailed Lithic Analysis

LA 51703 is a large, multicomponent scatter of lithics and ceramics. To the west the diffuse lithic scatter joins LA 51702. During the field operation, surface collections were made in four spatial units. Artifacts were recovered in Units 1, 2, and 3.

An examination of surface distributions resulted in the identification of five surface proveniences. Unit 1 included Provenience 2 (south of 128N) and Provenience 3 (north of 128N). Unit 2 included Provenience 1, a small lithic concentration measuring 2 x 13 m (103-104N/80-93E). Unit 2 also included Provenience 5, all grids not included in Provenience 1. Unit 3 (Provenience 4) was examined as one unit. Although three subsurface tests were excavated, no artifactual materials were recovered.

A total of 1,465 stone artifacts (surface and subsurface) was recovered from the site. Chipped stone debris totaled 1,464 (Table 6.57). One piece of ground stone was also recovered. A number of ceramics was also identified (Chapter 11). Historic and faunal remains were not found. Chipped stone included 1,406 flakes and pieces of small angular debris, 20 bifaces, two unifaces, one projectile point, one graver, six cores, and 26 pieces of large angular debris.

Table 6.57 LA 51703 Artifact Type to Material Type Frequencies (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

	Artifact Type									
Material Type	Biface	Core	Flake	Graver	Large Angular Debris	Miscellaneous	Projectile Point	Small Angular Debris	Uniface	Total
Miscellaneous	--(--)	--(--)	5(71)	--(--)	--(--)	--(--)	--(--)	2(29)	--(--)	7
Black Chert	--(--)	--(--)	5(100)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	5
Brown Jasper	--(--)	--(--)	5(100)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	5
Green Chert	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	1
Jemez Obsidian	--(--)	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	1
Moss Jasper	--(--)	--(--)	1(100)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	1
Nacimento Chert	--(--)	--(--)	2(67)	--(--)	--(--)	--(--)	--(--)	1(33)	--(--)	3
Pedernal Chert	18(1)	6(<1)	1,241(91)	--(--)	25(2)	2(<1)	--(--)	67(5)	2(<1)	1,361
Polvadera Obsidian	2(4)	--(--)	45(90)	--(--)	--(--)	--(--)	1(2)	2(4)	--(--)	50
Quartzitic Sandstone	--(--)	--(--)	6(86)	--(--)	--(--)	--(--)	--(--)	1(14)	--(--)	7
Quartzite	--(--)	--(--)	8(100)	--(--)	--(--)	--(--)	--(--)	--(--)	--(--)	8
Silicified Wood	--(--)	--(--)	14(93)	--(--)	1(7)	--(--)	--(--)	--(--)	--(--)	15
Total	20(1)	6(<1)	1,333(91)	1(<1)	26(2)	2(<1)	1(<1)	73(5)	2(<1)	1,464

Samples for detailed analysis were selected from Units 1, 2, and 3 on the basis of field distribution maps. A total of 290 artifacts underwent a detailed analysis. Included were Provenience 1 (77 artifacts), Provenience 2 (113 artifacts), Provenience 3 (67 artifacts), Provenience 4 (16 artifacts), and Provenience 5 (17 artifacts). A discussion of the rough sort data for each provenience is followed by a description of additional information provided by the detailed analysis.

Table 6.58 illustrates heat treatment. The only material type that exhibited heat treatment was Pedernal chert. Eighty-one percent of this chert (1,105 artifacts) was treated. This percentage is typical for most sites in the study area. Among heat treated artifacts 77 percent exhibited successful treatment (849 artifacts), and 23 percent were unsuccessfully treated. The detailed analysis examined heat treatment to determine if cores or flakes were heat treated. The sample recovered from this site indicates that both techniques were employed. Five artifacts had clear evidence of thermal surfaces remaining on both sides of the artifact indicating that they were heated as flakes.

Table 6.58 LA 51703 Heat Treatment by Artifact Type, Chert Only, Abiquiu Archaeological Study, ACOE, 1989.

	None		Total Treated		Total Successful		Total Unsuccessful		
	#	%	#	%	#	%	#	%	Total
Biface Flake	9	11	75	89	71	95	4	5	84
Biface	1	6	17	94	17	100	--	--	18
Biface Core	--	--	1	100	1	100	--	--	1
Multiplatform Core	--	--	1	100	1	100	--	--	1
Tested Core	--	--	1	100	1	100	--	--	1
Core Flake	158	20	618	80	450	73	168	27	776
Multiplatform Exhausted Core	--	--	3	100	3	100	--	--	3
Heat Spall	--	--	1	100	--	--	1	100	1
Large Angular Debris	2	8	23	92	11	48	12	52	25
Pressure Flake	3	50	3	50	3	100	--	--	6
Retouched Rock	1	100	--	--	--	--	--	--	1
Small Angular Debris	6	9	61	91	31	51	30	49	67
Unidentified Flake	70	20	284	80	243	86	41	14	354
Unifacially Retouched Flake	5	24	16	76	16	100	--	--	21
Uniface	1	50	1	50	1	100	--	--	2
Total	256	19	1,105	81	849	77	256	23	1,361

6.17.5.1 Unit 1, Provenience 2

Provenience 2 represents the south half of the unit, grids below 128N. A total of 388 stone artifacts was recovered from this area. Artifacts included 378 flakes and pieces of small angular debris, five bifaces, one graver, one core, and three pieces of large angular debris.

Pedernal chert comprised 93 percent of the assemblage (361 artifacts). This material group was followed in frequency by Polvadera obsidian (three percent, 12 artifacts). The remaining seven local materials included 15 artifacts. Due to the low counts in most material categories, reduction is discussed only for Pedernal cherts.

Six formal tools were recovered from Provenience 2 in Unit 1. Formal tools included one blank, three early bifaces, one graver, and one artifact with extensive unidirectional marginal retouch. The majority of artifacts recovered from this provenience was manufactured from Pedernal chert (five artifacts). A single graver was manufactured from Jemez obsidian.

The formal tools recovered provided additional data indicating that formal tool manufacture occurred at the site. With the exception of the graver, all artifacts were manufacturing failures. The evidence of resharpening combined with the lack of completed, used, and discarded tools indicated that formal tools were resharpened at the location and transported away. They may have been used here, but they were not worn out at this location.

All heat treatment on formal tools was successful. Four of five Pedernal artifacts were heat treated. The only nonheat treated item was a bifacial blank. This artifact represents early stages of manufacture and may indicate tentatively that heat treatment is not necessary during early stages of manufacture. The formal tool assemblage recovered from LA 51703 also indicates that early bifaces were manufactured on nonheat treated materials.

Further evidence of tool use in this provenience can be seen in the number of expedient flake tools and marginally retouched artifacts. Four Pedernal flakes exhibited unidirectional wear, and one Pedernal flake exhibited bidirectional wear indicating scraping and cutting activities. Unidirectional marginal retouch was identified on three artifacts. These data in addition to information provided by use on retouched platforms indicate that the provenience was used for a number of scraping and cutting activities. Expedient as well as formal tool use is represented. Unfortunately, no utilized flakes were recovered in the detailed sample so it was not possible to determine if use activities represented soft or hard tool use.

These data indicate that Provenience 2 was a use activity area as well as a formal tool manufacturing and resharpening area. Use wear and artifact types indicate considerable functional diversity. Scraping and cutting activities are indicated as well as graver use. Additional function is indicated by two flakes with dorsal battering, which is characteristic of ground stone resharpening. Although hearth features were not identified in this area, the abundant evidence of use activities and clear indication of heat treatment suggest that hearth features did exist on the site.

6.17.5.2 Unit 1, Provenience 3

Provenience 3 represents the lithic scatter in the northern portion of Unit 1 (north of 128N). A total of 368 chipped stone artifacts was recovered from this area. Ninety-seven percent were flakes and small angular debris (355 artifacts). Other artifacts included two bifaces, one uniface, one core, and nine pieces of large angular debris.

This portion of the site was very similar to Provenience 2, the southern half of Unit 1. Again, the primary material represented was Pedernal chert (95 percent, 350 artifacts). Low frequency local materials totaled five percent of the assemblage.

Additional evidence of formal tool manufacture can be seen in the formal tool assemblage. Formal tools included one biface blank, one uniface, and one artifact with extensive unidirectional, marginal retouch. All artifacts were incomplete manufacturing failures that were made from Pedernal chert. The artifact with extensive unidirectional retouch lacked evidence of heat treatment, while all others were successfully treated.

Additional evidence of tool use is indicated by the expedient flake tool and marginally retouched tools that were recovered. Three flake tools exhibited bidirectional wear indicating cutting activities, and five showed unidirectional wear indicative of scraping activities. The detailed analysis indicates that the wear pattern represents hard rather than soft use wear activities. Marginal retouch was identified on nine artifacts (eight unidirectional and one bidirectional). Flakes selected for expedient use and marginal retouch were not always heat treated. A single Pedernal flake exhibiting dorsal battering implies that ground stone may have been resharpened at the location. Use was identified on black chert and Pedernal chert.

The character of the assemblage in Provenience 3 is very similar to that identified in Provenience 2. Both bifacial and unifacial tool manufacture and resharpening are indicated. Formal as well as expedient tools were used.

6.17.5.3 Unit 2, Provenience 1

Provenience 1 represented a high density lithic concentration in Unit 2. The concentration was located in grids 103-104N/80-93E. Lithic artifacts totaled 301 (300 chipped stone and one piece of ground stone). Chipped stone artifacts included 287 flakes and pieces of small angular debris, six bifaces, one core, and six pieces of large angular debris.

The lack of platform use and the absence of utilized tools suggested that tool use activities did not occur in this location. An examination of retouched platforms did not identify remnants indicative of resharpening. Only platform preparation was identified. This area lacked evidence of expedient tool use or marginal retouch.

The formal tool assemblage was comprised primarily of manufacturing failures, supporting other evidence that this location was a manufacturing

area and not a use activity location. Seven formal tools were recovered from Provenience 1. They included six early bifaces and one projectile point. Five artifacts were manufactured from Pedernal chert while a projectile point and one early biface were manufactured from Polvadera obsidian. All Pedernal bifaces exhibited successful heat treatment.

The projectile point was the only completed artifact recovered. It was a basal fragment from a corner-notched palmate dart point.

One complete bifacial tool was recovered outside of the collection unit. It was manufactured from Polvadera obsidian and located in 111N/89E.

A one hand mano manufactured from quartzitic sandstone indicated that grinding activities occurred. The mano exhibited one convex grinding surface, was whole, and measured 87 x 65 x 45 mm. Additional evidence that grinding activities occurred was indicated by a Pedernal flake with dorsal battering characteristic of battering on ground stone sharpeners (peckers).

The assemblage recovered from Provenience 1 in Unit 2 represents primary, secondary, and tertiary reduction. Unlike Unit 1 this area of the site lacks evidence of chipped stone tool use activities. This area clearly represents a Pedernal chert formal tool manufacturing area. Grinding activities may have occurred in this location.

6.17.5.4 Unit 2, Provenience 5

Provenience 5 represented the surface lithic collection in Unit 2 excluding Provenience 1. A total of 218 chipped stone artifacts was recovered. Artifacts included 210 flakes and pieces of small angular debris, one biface, one uniface, one core, and four pieces of large angular debris. One non-cultural piece of debris was recorded.

The lithic assemblage recovered from Provenience 5 was more similar to the assemblages recovered from Unit 1 than the Unit 2 Pedernal concentration (Provenience 1) previously described. Again, Pedernal materials are being reduced, with other local materials constituting a small proportion of the assemblage.

This assemblage provided no evidence that formal tools were resharpened in this location; however, the assemblage clearly indicated that expedient tool use activities were carried out. Retouched platforms did not exhibit evidence of utilization. Expedient flake tools exhibited unidirectional (two Pedernal, one Polvadera) and bidirectional (two Pedernal) use indicating that scraping and cutting activities were carried out at the site. Marginal retouch was identified on nine artifacts in this area. Eight exhibited unidirectional marginal retouch and one bidirectional retouch.

A uniface and an early biface were identified in Provenience 5. Both were incomplete and manufactured from Pedernal chert. The uniface did not exhibit heat treatment.

The lack of complete formal tools and retouched platforms with remnant utilization suggested that formal tools were manufactured but not utilized in this location. Use activities are indicated, however, for expedient flake tools and marginally retouched artifacts. Both scraping and cutting activities are represented. The detailed sample did not indicate if hard or soft use was represented.

6.17.5.5 Unit 3, Provenience 4

Provenience 4 represented the entire surface collection from Unit 3. A total of 188 chipped stone artifacts was recovered from this unit. Artifacts included 177 flakes and pieces of small angular debris, four bifaces, two cores, four pieces of large angular debris, and one miscellaneous item.

Again, Pedernal chert comprised the majority of the assemblage (91 percent, 171 artifacts). The Pedernal assemblage represents all stages of reduction and formal tool manufacture.

Two multiplatform exhausted cores were recovered from this area. Both were manufactured from Pedernal chert and exhibited successful heat treatment.

Formal tools suggested that manufacture occurred in this area. Four manufacturing failures, three early bifaces and a uniface, were identified. All were manufactured from successfully treated Pedernal chert. The limited evidence of use on platforms and lack of completed formal tools indicated that the area was a formal tool manufacturing area, not an area where formal tools were utilized.

Expedient tool use was indicated. Three artifacts exhibited use (two unidirectional and one bidirectional) that represented scraping and cutting activities. Three unidirectionally marginally retouched artifacts provided additional evidence of use. One flake exhibited dorsal battering indicative of ground stone sharpening.

The Unit 3 lithic assemblage was similar to the majority of the site. Formal tool manufacture as well as primary reduction is indicated. Although different portions of the site exhibit variability, tool use in this area is primarily confined to more expedient tools.

6.17.5.6 Summary of Site Activity Areas

The assemblage recovered from LA 51703 indicated the manufacture and use of tools in a variety of activities. Tool manufacture and use varied across the site.

The surface of Unit 1 was collected in two units, but overall assemblage character was similar. Both areas (Proveniences 2 and 3) indicated formal tool manufacture and resharpening as well as formal and expedient tool utilization. Artifact variability suggests functional diversity and grinding activities probably occurred.

The high density Pedernal assemblage in Unit 2 (Provenience 1) represented a formal tool manufacturing area but lacked evidence of chipped stone use activities. Grinding activities were indicated.

The remainder of the assemblage in Unit 2 (Provenience 5) indicated formal tool manufacture and expedient tool use. Expedient tools represented scraping and cutting activities. Formal tool use was not indicated.

Provenience 4 (Unit 3) represented formal tool manufacture with limited evidence of formal tool use. Expedient tool use activities appeared to dominate this area.

6.17.6 Summary

This multicomponent site contained historic Apache ceramics dating from the A.D. 1830s-1870s and a late Archaic projectile point. A total of 1,465 lithic and 75 ceramic artifacts was collected from 410 m^2 of surface collection and 3 m^2 of subsurface testing.

6.18 LA 51704

6.18.1 Physiographic Setting

This site is located in a cleared area, probably an abandoned field, which slopes uniformly and gradually north-northeast. The area is bounded by slightly steeper slopes of erosional features to the west, north, and east. It ranges in elevation from 6292 to 6310 feet; it is bounded by a two-track road to the west and bisected by another two-track running east-northeast/south-southwest. The substrate is uniform colluvium, plowed or graded several decades ago as evidenced by numerous piles of rotted brush created by clearing activities associated with mechanical disturbance.

6.18.2 Field Methods

The area of LA 51704 had been proposed as an alternative, unimproved parking lot to serve users of the temporary boat ramp located on LA 51702. Preliminary inspection was carried out by the Project Field Director, Jack B. Bertram, and by Mr. James Talent, Manager of Abiquiu Reservoir. Although sparse, scattered concentrations of artifacts were noted along deflated roadways and erosional rills at the area's boundaries, no artifacts were seen within the anticipated parking lot limits. It was decided to erect fencing denying access by users to eroded areas; in addition, it was concluded that testing was indicated to determine if subsurface deposits underlay the proposed use area, as was suggested by the items noted but not recorded at the area's margins. Fence lines were laid out, and the area so bounded was tested by the excavation of three 1 x 1 m test pits and auger soundings.

6.18.3 Collection Units

Prior to the excavation of each pit, an area of 314 m^2 was surface collected by a 10-m radius dog leash, centered about the southwest corner of each unit. All encountered items were collected and piece-plotted using a Brunton compass and chaining.

A very sparse (0.005 item/m^2 estimate) artifact density was observed but not recorded outside the area of proposed and past disturbance. Within the proposed area, 924.5 m^2 were completely collected; only three flakes were recovered.

The three units were placed judgmentally; they were spaced uniformly at 100N/100E, 100N/130E, and 100N/160E, along a baseline chosen to transect the proposed parking area along an east-west axis (Figures 6.64-6.66).

Figure 6.64 LA 51704, N100/E100, South Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

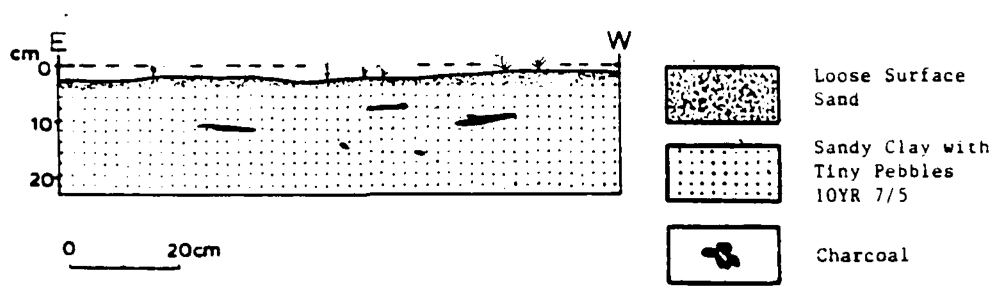


Figure 6.65 LA 51704, N100/E130, West Wall Profile, Abiquiu Archaeological Study, ACOE, 1989.

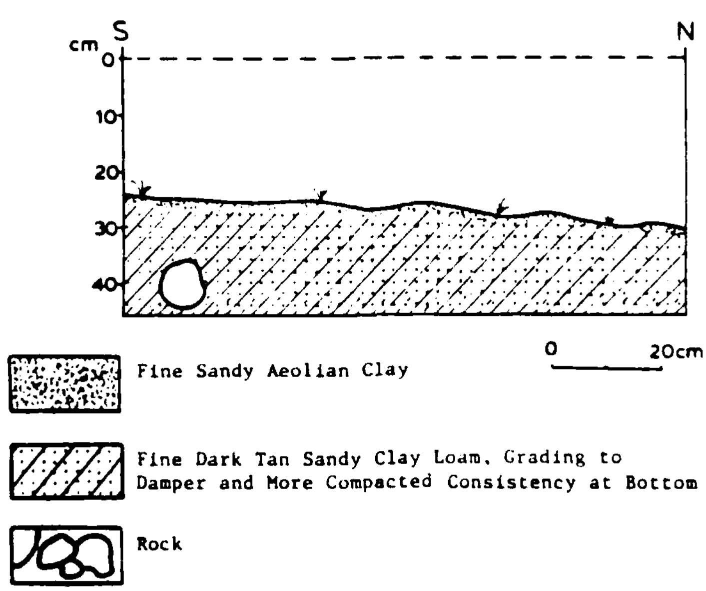
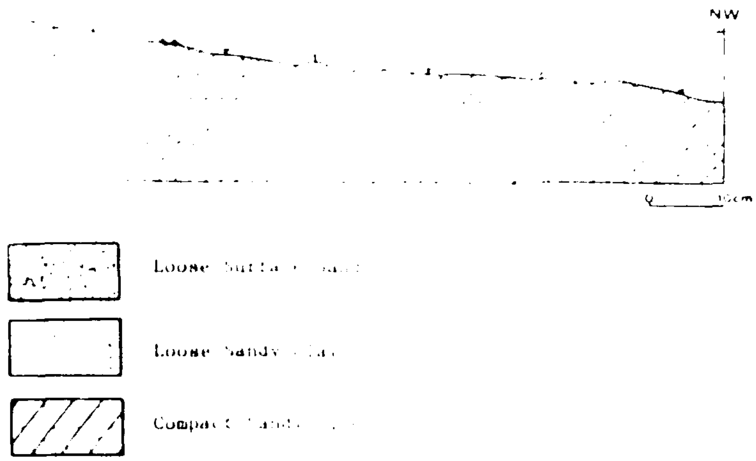


Figure 6.66 ... West Wall Profile, An... Archaeological



6.18.4 Subsurface Samples and Stratigraphy

All test pits were excavat... 0 cm below surface; a 15-cm diameter auger hole was then dug in the ... of each test pit to a depth of not less than ... m below surface. All test ... and auger spoil was screened through 1/4 inch mesh. Excavated ... yielded no cultural materials; no stains indicating ash or midden were encountered. Samples are listed in Table 6.59.

Table 6.59 LA 51704 Samples, A... Archaeological Study, ACOE, 1989.

Provenience	Flotation	Pollen	C-14
S100/E100, Level 1	1	1	--
S100/E130, Level 1	1	1	--
S100/E160, Level 1	1	1	--

6.18.5 Summary of Site Formation Process

Evidence of cultural occupation of this probable old field was limited to three flakes (0.0032 item/m^2). It is likely that no site was ever present at this location; adjacent lithic scatters probably represent the extreme edges of LA 51701, LA 51700, LA 25533, LA 34913, and LA 34914. No evidence of buried materials was encountered.

6.19 LA 51699

6.19.1 Physiographic Setting

This small structural site with associated lithic scatter is located on a small cliff bench directly overlooking the Rio Chama Canyon, the bottom of which lies 80 m south and 70 m below the site. The bench containing the site lies at an elevation of 6280 to 6290 feet. At the time of visitation, the bench was undergoing very rapid collapse as a result of rising water levels. The site area was unquestionably dangerous, as slumping proceeded perceptibly while recording was being carried out. Prior to slumping, the site area was undergoing erosion; sparse patches of loam/scree supported stands of grass, juniper, and sage.

6.19.2 Field Methods

Due to the dangerous setting of this previously unreported site, field recordation procedures were abbreviated. Those portions of the site which could be safely traversed were mapped; all artifacts encountered were collected and their locations recorded by angle and distance from datum. Areas of the site lying southwest, south, or east of the structure were not examined (Figure 6.67).

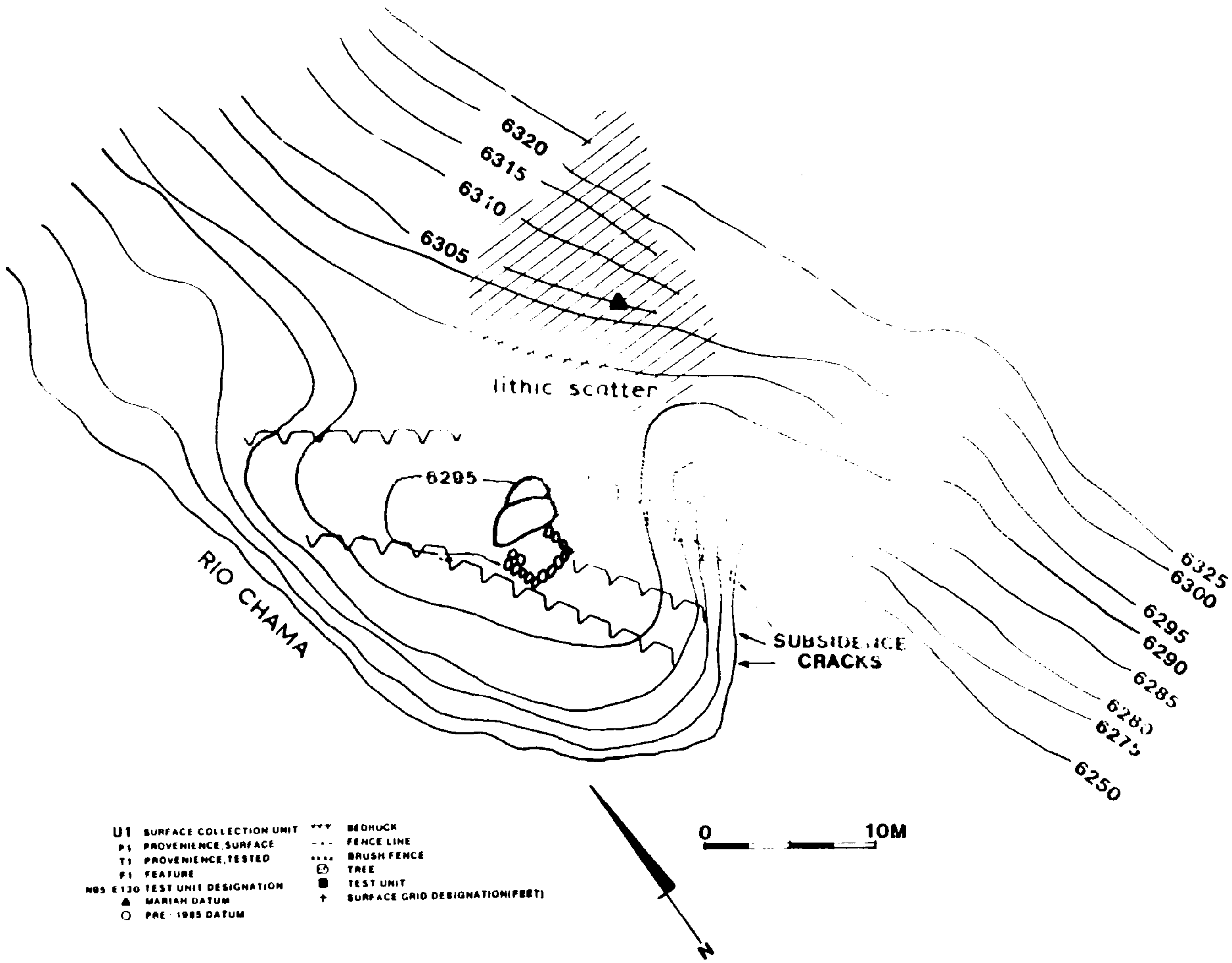
6.19.3 Surface Artifacts and Features

The structure consisted of a dry-laid, 2 x 3 m masonry rectangle constructed on and to the south of an upthrust bedrock outcrop. Slabs were of thin, tabular, local sandstone, horizontally laid; no evidence of mortar was seen. The structure was not tested, as it clearly had begun to collapse due to very rapid bench slumping. A sparse, 28 x 14 m lithic scatter lay north-northeast of the structure. All items observed were collected; these totaled 25 and included two spent Pedernal chert multiplatform cores and one piece of large angular debris and 21 pieces of debitage, [illegible] of which were primary (Table 6.60).

Table 6.60 LA 51699 Material Type to Artifact Type Frequencies (Row Percentage in Parentheses), Abiquiu Archaeological Study, ACOE, 1989.

Material Type	Artifact Type: Misc.	Core	Flake	Large Angular Debris	Small Angular Debris	Total
Pedernal Chert	1(4)	2(8)	17(71)	1(4)	3(13)	24
Vitrophyre Basalt	--(--)	--(--)	1(100)	--(--)	--(--)	1
Total	1(4)	2(8)	18(72)	1(4)	3(12)	25

Figure 6.67 LA 51699, Abiquiu Archaeological Study, ACOE, 1989.



Due to the evident risk of collapse of the site bench, no testing was carried out.

6.19.4 Rough Sort Lithic Analysis

LA 51699 consisted of a light scatter with a single masonry room. The entire surface collection was examined as a single provenience (Provenience 1). No subsurface test pits were excavated.

The assemblage was almost exclusively manufactured from Pedernal chert (96 percent, 24 artifacts). A single flake was manufactured from vitrophyre basalt.

An examination of heat treatment indicates that 79 percent (19 artifacts) of the Pedernal cherts were heat treated. Of these, 89 percent (17 artifacts) were successfully treated while 11 percent (two artifacts) were unsuccessfully heat treated.

Table 6.61 indicates that a comparatively large percentage of core flakes was heat treated (78 percent). Most sites exhibit lower percentages of heat treatment among core flakes.

Table 6.61 LA 51699 Heat Treatment to Artifact Type Frequencies for [illegible] Site, Abiquiu Archaeological Study, ACOE, 1989.

	None		Treated		Successful		Unsuccessful		Total
	#	%	#	%	#	%	#	%	
Miscellaneous	1	100	--	--	--	--	--	--	1
Multiplatform Core	1	50	1	50	1	100	--	--	2
Core Flake	3	18	14	82	13	93	1	7	17
Large Angular Debris	--	--	1	100	1	100	--	--	1
Small Angular Debris	--	--	3	100	2	66	1	33	3
Total	5	21	19	79	17	89	2	11	24

When dorsal cortex and platform type were examined, the assemblage appears to represent the primary decortication of Pedernal chert. Although some secondary, noncortical debris is present (17 percent, four flakes), the majority of debris exhibits cortex. No evidence of formal tool manufacture was identified. Two multiplatform cores manufactured from Pedernal chert were also recovered. One was heat treated; the other was not.

No evidence of expedient or formal tool use was noted.

6.19.5 Summary

LA 51699 consisted of a sparse lithic scatter associated with a stacked-stone, rectangular structure of one room. A total of 25 lithic items was collected, over an examined surface area of approximately 700 m^2. No tests were conducted. Subsequent to fieldwork, it is probable that the site was destroyed by cliff collapse.

6.20 SITE REPORT CONCLUSIONS

This section discusses some general trends in material selection, reduction, and tool production that were identified in the lithic assemblages.

6.20.1 Heat Treatment

Heat treatment is an attribute that can provide information about strategies of tool manufacture and core reduction. In addition this attribute can provide information about activities that occur at archaeological sites and can potentially indicate hearth features that are no longer present in the archaeological record.

Whatley and Rancier (1986) pointed out that the majority of bifacial tool manufacture occurred on heat treated materials. The individual site reports indicate that a large percentage of Pedernal chert formal tools and debitage from formal tool manufacture exhibit heat treatment and that generally the heat treatment is successful.

Formal tool assemblages in conjunction with debitage from various sites indicate that in some cases early stages of bifacial manufacture occurred on nonheat treated materials. This is evident in assemblages with nonheat treated blanks, early bifaces, and bifacial debitage. It appears that in some cases these early stage bifaces were roughed out on nonheat treated materials, then heat treated to facilitate further bifacial manufacture. The number of early bifaces exhibiting unsuccessful heat treatment appears to support this. These artifacts are too numerous to represent the occasional bifaces that fell into the fire. Additionally, it is unlikely that bifacial manufacture would be carried out on already unsuccessfully heat treated materials. Unsuccessful heat treatment results in crazing, pot lids, and general internal fracturing that would cause breakage during bifacial manufacture.

Heat treatment proved to be a significant factor in assemblage variability when collection units for all sites were examined. Results of the cluster analysis on percentage of Pedernal chert and of heat treatment are presented in Chapter 9.

Heat treatment on biface flakes and core flakes was summarized to aid in identifying potential strategies of heat treatment and tool production (Table 6.62). Four general patterns of heat treatment were identified based on biface and core flake treatment. Biface flake treatment is considered evidence of tool manufacture, while core flake treatment relates to core reduction not necessarily involving tool production. These represent variable strategies of heat treatment and tool production. These heat treatment patterns are described as Types A, B, C, and D. Two sites exhibited heat treatment patterns that were not similar to these types.

Table 6.62 Heat Treatment Summary, Abiquiu Archaeological Study, ACOE, 1989.

Heat Treatment Classification Type	Site or Provenience	Biface Flakes						Core Flakes					
		Not Treated		Treated		Unsuccessful		Not Treated		Treated		Unsuccessful	
		#	%	#	%	#	%	#	%	#	%	#	%
A	25328 Prov. 4	8	22	28	78	1	4	167	48	180	52	3	2
A	25328 Prov. 5	50	16	259	84	3	1	358	33	740	67	54	7
A	25330 All	10	14	60	86	--	--	241	46	284	54	70	25
A	27002 All	3	14	18	86	4	22	64	41	92	59	45	49
A	27018 All	42	15	233	85	--	--	249	33	494	67	124	25
A	27020 All	2	9	20	91	--	--	36	32	75	68	37	49
A	27042 All	1	4	27	96	--	--	19	37	33	63	13	39
A	51702 All	3	12	23	88	1	4	103	39	161	61	32	20
B	25332 All	--	--	17	100	--	--	59	19	248	81	85	34
B	25480 All	10	6	150	94	5	3	35	13	234	87	36	15
B	27004 All	4	8	48	92	1	2	8	15	46	85	13	28
B	27041 All	5	5	87	95	4	5	15	6	227	94	75	33
B	51700 All	14	21	52	79	1	2	49	21	180	79	54	30
B	51703 All	9	11	75	89	4	5	158	20	618	80	168	27
C	25328 Prov. 3	18	53	16	47	1	6	277	50	277	50	56	20
C	51698 All	4	44	5	56	1	20	18	47	20	53	3	15
D	25333 All	--	--	--	--	--	--	11	21	42	79	13	31
D	51699 All	--	--	--	--	--	--	4	22	14	78	1	7
?	25328 Prov. 1&2	--	--	1	100	--	--	13	54	11	46	1	9
?	51701 All	8	89	1	11	--	--	75	69	34	31	12	35

Type A represents assemblages that exhibit high percentages of heat treatment on bifacial flakes (80-90 percent), while core flakes exhibit heat treatment on 50-70 percent. These assemblages indicate that the majority of bifacial manufacture occurs on heat treated materials and that core reduction occurs on both heat treated and nonheat treated materials, suggesting a dual heat treatment strategy for core reduction.

It does not appear that this variability in heat treatment on core debitage relates to a more expedient tool production strategy. Expedient flake tools and marginally retouched artifacts were examined for heat treatment to determine if nontreated flakes were being manufactured as the result of expedient tool production strategies. This is not the case. It appears that flakes that were used expediently were randomly selected from heat treated and nonheat treated debitage.

Assemblage Type B exhibits high percentages of heat treatment on core reduction debitage (79-85 percent) as well as formal tool manufacturing debitage (79-100 percent). These assemblages suggest that heat treatment was carried out routinely for formal tool manufacture and core reduction.

Assemblage Type C exhibits equal proportions of heat treated and nonheat treated materials within categories of biface flakes and core flakes. Heat treatment was identified on 50-56 percent of biface flakes and 50-53 percent of core flakes. Where the majority of sites suggests that more heat treatment occurred during formal tool manufacture than during core reduction, Type C assemblages indicate that heat treatment was in some cases equally common for both manufacture and reduction. LA 51698 (all) and LA 25328 (Provenience 3) exhibit a late occupation (Developmental Period on LA 25328 and Piedra Lumbre Phase and later Historic Period on LA 51698) that may contribute to this patterning. It is possible that the early components of these assemblages exhibit similar patterning to assemblage Types A and B and that heat treatment was not used during the later occupation, thus lowering the overall percentages. Because these sites appear to represent multiple reuse areas, it is difficult to determine which factors contributed to the patterning identified. Multicomponent lithic concentrations with multiple dates reported in this study were not well suited to examining temporal differences in heat treatment.

Assemblage Type D was identical to Type B except for a lack of evidence of bifacial tool manufacture and was therefore separated from assemblage Type B. The percentages of heat treatment among core flakes, however, were similar. The relatively small lithic assemblages on these two sites were unusual only in their absence of bifacial flakes.

The two aberrant sites (LA 25328, Proveniences 1-2, and LA 51701) were also distinguished during the cluster analysis on site proveniences (section 9.1). Except for Unit 2 on LA 51701, which was in the high percentage Pedernal and high percentage heat treatment cluster, the aberrant site units fell into low heat treatment clusters, with LA 51701 Unit 1 having a high percentage of Pedernal chert in the assemblage and Proveniences 1-2 of LA 25328 having low percentages of Pedernal chert. Results of the cluster analysis are discussed further in section 9.1.

Successful and unsuccessful heat treatment was examined to aid in determining the stage of reduction and manufacture at which heat treatment occurred and to identify where heat treatment activities were carried out. One would expect heat treatment to occur in close proximity to areas of material acquisition. This way only successfully treated materials need to be transported. Unsuccessfully treated materials can be left behind. Data presented in Table 6.62 show that the percentage of unsuccessfully heat treated core flakes was variable and may indicate whether heat treatment occurred at the site or at another location. A number of sites exhibited relatively low percentages of unsuccessful heat treatment (2-15 percent) suggesting that heat treatment occurred at another location. Conversely, some sites exhibited relatively high percentages of unsuccessful heat treatment (25-49 percent) suggesting that heat treatment occurred at the site. On-site treatment implies that hearth features were present, assuming that unsuccessfully treated items would not be transported away from the heat treatment location. Only 10 hearths on five sites (LA 25328, LA 25330, LA 51698, LA

27018, and LA 27020) were encountered during this study, making the hearth and heat treatment comparison difficult. These sites do not exhibit higher percentages of unsuccessful heat treatment than do sites without known hearths.

6.20.2 Material Selection

The percentages of various materials represented within proveniences across sites were examined to aid in identifying patterns of material acquisition. Table 6.63 summarizes the dominant materials represented on sites in the study area.

As expected a large percentage of proveniences exhibited high percentages of Pedernal chert. This material was most abundant and generally of high quality so its selected use was expected.

Table 6.64 indicates three general patterns of material selection. The majority of assemblages exhibited high percentages of Pedernal chert with the remaining debitage representing Polvadera obsidian. Within these assemblages there are proveniences with between 80 and 100 percent Pedernal chert and a small complement of Polvadera obsidian (Type 1A), and there are assemblages with smaller percentages of Pedernal chert (50-80 percent) and a greater amount of Polvadera obsidian (Type 1B). The initial variability in amounts of Pedernal chert may have to do with distance from terrace gravels. Other variability may correlate with time period. It appears that some of the variability in material selection is related to function. Polvadera obsidian is a material that produces sharp edges, but edges that are not as durable as Pedernal chert.

The second assemblage pattern identified represents higher percentages of Polvadera obsidian than Pedernal chert (Type 2). These assemblages appear to represent distinct manufacturing or use areas. They are clearly distinct from Type 1A and 1B assemblages.

The third type of assemblage generally exhibits both Pedernal chert and Polvadera obsidian, but at least six percent of the total assemblage is made up of a material type other than Pedernal or Polvadera. These materials include Jemez obsidian (LA 25480, Proveniences 1, 2, and 3; LA 27042, Provenience 5; and LA 51698, Provenience 5), fossiliferous tan chert (LA 25333), quartzitic sandstone (LA 27018, Proveniences 2 and 4), and other materials (LA 27041, Provenience 1).

6.20.3 Reduction

Table 6.65 summarizes reduction among high frequency material types. Assemblages are characterized as Primary (P), Secondary (S), and Tertiary (T). Capital letters represent distinct evidence of a particular type of reduction while lower case letters indicate that a type of reduction is represented but not in expected frequency.

Primary, secondary, and tertiary reduction is viewed as a sequence of core reduction and formal tool manufacture. Primary reduction represents decortication while secondary reduction debitage includes noncortical flakes that lack distinct morphology representing formal tool manufacture. Tertiary debitage exhibits attributes that represent formal tool manufacture.

Table 6.63 Material Selection Summary, Abiquiu Archaeological Study, ACOE, 1989.

Site #	Provenience	Total # Artifacts	Pederral Chert #	Pederral Chert %	Polvadera Obsidian #	Polvadera Obsidian %	Jemez Obsidian #	Jemez Obsidian %	Fossiliferous Tan Chert #	Fossiliferous Tan Chert %	Quartzitic Sandstone #	Quartzitic Sandstone %	Other Materials #	Other Materials %
25328	1	256	44	17	206	80	3	1	--	--	--	--	3	1
	2	63	19	30	22	35	2	3	--	--	14	22	6	10
	3	288	265	92	23	8	1	<1	--	--	--	--	--	--
	4	1,042	856	82	167	16	1	<1	--	--	8	1	4	<1
	5	213	180	85	28	13	1	<1	--	--	2	1	1	<1
	6	992	809	81	156	16	11	1	--	--	9	1	9	1
	7	2	--	--	2	100	--	--	--	--	--	--	--	--
	8	865	607	70	162	19	6	1	1	<1	78	9	12	1
	9	8	3	38	2	25	2	25	--	--	--	--	1	12
	10	4,974	4,002	81	582	12	32	1	--	--	246	5	108	1
	11	358	301	84	27	8	2	1	--	--	23	6	5	1
	12	936	896	96	32	3	6	1	--	--	1	<1	1	<1
25330	1	1,203	916	76	232	19	9	1	1	<1	20	2	25	2
	2	456	427	94	12	3	3	1	--	--	6	1	8	1
	3	250	201	80	41	16	1	<1	--	--	3	1	6	2
25333	All	134	68	51	22	16	2	1	19	14	16	12	7	6
25480	1	693	372	54	188	27	127	18	1	<1	--	--	6	1
	2	1,054	478	45	217	21	359	34	--	--	--	--	--	--
	3	1,107	418	38	584	53	101	9	--	--	3	<1	1	<1
	4	667	189	28	455	68	14	2	1	<1	5	1	4	1
	5	1	1	100	--	--	--	--	--	--	--	--	--	--
25532	1	133	83	62	38	29	8	6	--	--	1	1	3	2
	2	38	5	13	32	84	1	3	--	--	--	--	--	--
	3	165	92	56	67	41	4	2	--	--	--	--	2	1
	4	158	128	81	23	15	1	1	--	--	1	1	5	2
	5	27	19	70	5	19	--	--	--	--	--	--	3	11
	6	472	216	46	244	52	5	1	1	<1	1	<1	5	1
27002	All	451	299	66	136	30	6	1	1	<1	2	<1	7	2
27004	1	131	127	97	--	--	--	--	--	--	4	3	--	--
	2	147	133	90	8	5	--	--	--	--	5	3	1	2
	3	22	22	100	--	--	--	--	--	--	--	--	--	--
27020	1	242	153	63	82	34	2	1	--	--	2	1	3	1
	2	8	8	100	--	--	--	--	--	--	--	--	--	--
	3	4	2	50	1	25	--	--	--	--	1	25	--	--
	4	113	79	70	28	25	--	--	--	--	5	5	1	1

Table 6.63 (Continued).

Site #	Prove-nience	Total # Artifacts	Pedernal Chert #	Pedernal Chert %	Polvadera Obsidian #	Polvadera Obsidian %	Jemez Obsidian #	Jemez Obsidian %	Fossiliferous Tan Chert #	Fossiliferous Tan Chert %	Quartzitic Sandstone #	Quartzitic Sandstone %	Other Materials #	Other Materials %
27041	1	127	82	65	17	13	--	--	--	--	6	5	22	17
	2	976	704	72	224	23	--	--	18	2	--	--	30	3
	3	53	31	58	18	34	--	--	--	--	3	6	1	2
27042	1	45	43	96	1	2	1	2	--	--	--	--	--	--
	2	55	51	94	2	4	1	2	--	--	--	--	1	2
	3	98	1	1	97	99	--	--	--	--	--	--	--	--
	4	72	24	33	40	56	6	8	--	--	--	--	2	3
	5	138	37	27	61	44	30	22	--	--	5	4	5	3
	6	33	--	--	33	100	--	--	--	--	--	--	--	--
	7	9	9	100	--	--	--	--	--	--	--	--	--	--
	8	20	5	25	15	75	--	--	--	--	--	--	--	--
	9	7	3	43	4	57	--	--	--	--	--	--	--	--
51698	1	5	3	60	--	--	--	--	--	--	--	--	2	40
	2	65	41	63	15	23	4	6	--	--	4	6	1	2
	3	24	15	63	8	33	1	4	--	--	--	--	--	--
	4	6	6	100	--	--	--	--	--	--	--	--	--	--
	5	18	--	--	2	11	16	89	--	--	--	--	--	--
	6	9	6	68	2	22	--	--	--	--	1	11	--	--
	7	2	2	100	--	--	--	--	--	--	--	--	--	--
51699	All	24	23	96	--	--	--	--	--	--	--	--	1	4
51700	1	167	139	83	19	11	4	2	--	--	--	--	5	4
	2	205	186	91	10	5	3	1	--	--	--	--	6	3
	3	532	275	52	235	44	11	2	--	--	--	--	11	2
	4	61	50	82	8	13	--	--	--	--	--	--	3	5
51701	1	127	103	81	--	--	1	1	--	--	--	--	23	18
	2	73	63	86	7	10	3	4	--	--	--	--	--	--
51702	All	454	445	98	3	1	--	--	--	--	1	<1	5	1
51703	1	300	279	93	11	4	--	--	--	--	1	<1	9	3
	2	388	361	93	12	3	1	<1	--	--	1	<1	13	3
	3	368	350	95	7	2	--	--	--	--	2	1	9	3
	4	188	171	91	10	5	--	--	--	--	1	1	6	3
	5	218	199	91	9	4	--	--	--	--	2	1	8	4

Table 6.63 (Continued).

Site #	Provenience	Total # Artifacts	Pedernal Chert #	Pedernal Chert %	Polvadera Obsidian #	Polvadera Obsidian %	Jemez Obsidian #	Jemez Obsidian %	Fossiliferous Tan Chert #	Fossiliferous Tan Chert %	Quartzitic Sandstone #	Quartzitic Sandstone %	Other Materials #	Other Materials %
27018	1	312	226	72	50	16	3	1	--	--	17	5	16	5
	2	535	448	84	31	6	4	1	--	--	30	6	22	4
	3	397	245	62	122	31	8	2	--	--	10	3	12	3
	4	1,095	685	63	221	20	5	<1	--	--	156	14	28	3
	5	149	142	95	4	3	1	1	--	--	2	1	--	--
	6	587	577	98	3	1	--	--	--	--	2	<1	5	1
	7	121	121	100	--	--	--	--	--	--	--	--	--	--
	8	10	9	90	1	10	--	--	--	--	--	--	--	--

Table 6.64 Material Selection Variability, Abiquiu Archaeological Study, ACOE, 1989.

Site #	Prove-nience	Type 1A[1]	Type 1B[2]	Type 2[3]	Type 3[4]	Comments
25328	1			X		
	2				X	
	3	X				
	4	X				
	5	X				
	6	X				
	7					Low Count
	8		X			
	10	X				
	11	X				
	12	X				
25330	1		X			
	2	X				
	3	X				
25333	All				X	
25480	1				X	
	2				X	
	3			X--both	---X	
	4			X		
	5					Low Count
25332	1		X			
	2			X		
	3		X			
	4	X				
	5		X			
	6		X			
27002	All		X			
27004	1	X				
	2	X				
	3	X				
27020	1		X			
	2					Low Count
	3					Low Count
	4		X			
27041	1				X	
	2		X			
	3		X			

Table 6.64 (Continued).

Site #	Provenience	Type 1A[1]	Type 1B[2]	Type 2[3]	Type 3[4]	Comments
27042	1	X				
	2	X				
	3			X		
	4			X		
	5			X--both	---X	
	6			X		
	7					Low Count
	8			X		
51698	1					Low Count
	2		X			
	3		X			
	4					Low Count
	5				X	
	6		X			
	7					Low Count
51699	All	X				
51700	1	X				
	2	X				
	3		X			
	4	X				
51701	1	X				
	2	X				
51702	All	X				
51703	1	X				
	2	X				
	3	X				
	4	X				
	5	X				

Table 6.64 (Continued).

Site #	Provenience	Type 1A[1]	Type 1B[2]	Type 2[3]	Type 3[4]	Comments
27018	1		X			
	2	X			X	
	3		X			
	4				X	
	5	X				
	6	X				
	7	X				
	8	X				

1 Pedernal 80-100 percent, Polvadera most of remaining 0-20 percent.

2 Pedernal 50-80 percent, Polvadera most of remaining 20-50 percent.

3 Polvadera 40-100 percent greater than Pedernal.

4 At least six percent is a material type other than Pedernal or Polvadera.

Table 6.65 Reduction Summary, Abiquiu Archaeological Study, ACOE, 1989.

Site #	Prove- nience	Pedernal Chert	Polvadera Obsidian	Jemez Obsidian	Fossiliferous Tan Chert	Quartzitic Sandstone	Other Materials	Heat Treatment Occurred at The Site
25328	1	pS	pSt	ST	--	SP	--	No
	2	pSt	ST	ST	--	S	S	No
	3	pST	pST	ST	--	--	--	?
	4	pSt	pSt	ST	--	S	P	No
	5	pST	pST	pSt	S	pST	PST	
	6	St	St	ST	--	--	--	
	7	Sp	Sp	S	--	S	P	
	8	pSt	St	S	S	P	S	
	9	--	--	--	--	--	--	
	10	pSt	pSt	Sp	S	Sp	S	
	11	pST	ST	S	--	p	T	
25330	1	pst	PST	--	--	--	--	Yes
	2	St	--	--	--	S	--	
	3	PST	PST	--	--	--	--	
	9	--	--	--	--	--	--	
25333	All	--	--	--	Ps	--	--	Yes
25480	1	ST	ST	ST	--	--	--	No
25532	1	PS	PSt	--	--	--	--	Yes
	2	--	Pst	--	--	--	--	
	3	PSt	pST	--	--	--	--	
	4	PSt	psT	--	--	--	--	
	5	--	--	--	--	--	--	
	6	PSt	pST	--	--	--	--	
27002	All	PSt	PST					Yes
27004	1	pST	--	--	--	--	--	Yes
	2	pST	--	--	--	--	--	
	3	--	--	--	--	--	--	
27018	1	pSt	ST	ST	S	SP	S	
	2	pSt	ST	ST	S	ST	ST	
	3	pSt	pST	ST	--	S	PS	
	4	pSt	pST	PST	--	pS	PST	
	5	pSt	ST	S	--	S	--	
	6	pST	ST	--	--	S	S	
	7	pST	--	--	--	--	--	
	8	ST	P	--	--	--	--	

Table [illegible] continued

Site #	Provenience	Pedernal Chert	Polvadera Obsidian	Jemez Obsidian	Fossiliferous Tan Chert	Quartzitic Sandstone	Other Materials	Heat Treatment Occurred at The Site
27[illegible]	1	PsT	pST	--	--	--	--	Yes
	2	--	--	--	--	--	--	
	3	--	--	--	--	--	--	
	4	PST	PST	--	--	--	--	
27041	1	ST	ST	--	--	--	--	Yes
	2	ST	pST	--	--	--	ps[1]	
	3	-	--	--	--	--	--	
27042	1	psT	--	--	--	--	--	Yes
	2	psT	--	--	--	--	--	
	3	--	ST	--	--	--	--	
	4	psT	PSt	--	--	--	--	
	5	pst	pst-T	pST	--	--	--	
	6	--	--	--	--	--	--	
	7	--	--	--	--		--	
	8	--	--	--	--	--	--	
	9	--	--	--	--	--	--	
51698	1	--	--	--	--	.	--	?
	2	PSt	ST	--	--	--	--	
	3	PST	PST	--	--	.	--	
	4	--	--	--	--	--	--	
	5	--	--	--	--	--	--	
	6	--	--	--	--	--	--	
	7	--	--	--	--	--	--	
51699	All	Ps	--	--	--	--	--	No
51700	1	pSt	ps	--	--	--	--	Yes
	2	St	T	--	--	--	--	
	3	pSt	Pst	--	--	--	--	
	4	St	--	--	--	--	--	
	9	--	--	--	--	--	--	
51701	1	pST	--	--	--	--	--	Yes
	2	PST	--	--	--	--	--	
51702	All	PST	--	--	--	--	--	?

Table 6.65 (Continued)

Site #	Provenience	[illegible]	Polvadera Obsidian	Jemez Obsidian	Fossiliferous Tan Chert	Quartzitic Sandstone	Other Materials	Heat Treatment Occurred at The Site
51[illegible]3		--	--	-	--	--	-	Yes
		PST	--	--	--	--	--	
		PST	--	--	--	--	-	
		--	--	--	--	--	--	
		PSt	--	--	--	--	--	

[illegible]liferous tan chert.

It is [illegible] Table 6.65 that occupants of the sites examined in the study area [illegible] use of abundant locally available raw materials. These ma[illegible] generally included Pedernal chert and Polvadera obsidian. Occasiona[illegible] common materials were used (Jemez obsidian, fossiliferous tan chert, [illegible]iferous cream chert, and quartzitic sandstone).

W[illegible] exception of LA 27041 and LA 25480, sites exhibit all stages of reduc[illegible] manufacture. LA 27041 exhibits little evidence of primary decort[illegible] suggesting that materials were transported to the site as prepared [illegible]. An examination of heat treatment indicates that heating probably occurr[illegible] the site, which would indicate that prepared cores rather than raw nodules were heated. The assemblage that was recovered from LA 25480 also lacks evidence of decortication; however, it appears that heat treatment in this case did not occur at the site. This assemblage indicates that decortication probably occurred at the same location where heat treatment was carried out.

Evidence of formal tool manufacture is indicated in assemblages from all sites. Some of these assemblages are purely tool manufacturing areas and others represent tool manufacturing and use areas. Pedernal chert and Polvadera obsidian were clearly used consistently in the manufacture of formal tools. The less common material types, with the exception of Jemez obsidian, generally do not represent formal tool manufacture. The fossiliferous tan chert, fossiliferous cream chert, and quartzitic sandstone assemblages represent decortication and secondary reduction. Jemez obsidian, on the other hand, represents formal tool manufacture.

6.2C.4 Functional Variability

The artifact variability that was identified on sites in the study area indicates that sites were used for a variety of functional activities in addition to formal tool manufacture. Although formal tools on many sites represent manufacturing failures, some assemblages provide clear evidence that tools were resharpened and utilized at the location. Table 6.66 compares the artifact variability within and between sites in the study area.

The multiple reuse of many sites is indicated by the multitude of dates given in Chapters 7 and 8. Chapter 9 shows that LA 27002 and LA 25480 concentrations tend to have many obsidian and other chronometric dates from different time periods in a limited space. Chapters 7 and 8 indicate that a site such as LA 27042, with limited artifact variability, is the result of intensive occupations during the En Medio Phase and Early Developmental Period, with more ephemeral occupations beginning in the San Jose Phase and ending in the Coalition Period.

Artifacts indicated that a number of tool manufacturing and maintenance activities were carried out. Both drills and gravers were represented. While projectile points indicated that hunting activities were carried out in the area (points with basal snaps), the use wear on scraping tools (subsumed under unifaces) did not indicate that hide preparation occurred. This may represent a bias resulting from the small detailed sample.

Table 6.66 Artifact Variability Summary, Abiquiu Archaeological Study, ACOE, 1989.

Site #	Provenience	Biface #	Biface %	Core #	Core %	Drill #	Drill %	Flake #	Flake %	Graver #	Graver %	Knapper #	Knapper %	Large Angular Debris #	Large Angular Debris %	Miscellaneous #	Miscellaneous %	Projectile Point #	Projectile Point %	Small Angular Debris #	Small Angular Debris %	Uniface #	Uniface %	Total
25328	1	3	1	1	<1	--	--	240	94	--	--	--	--	--	--	--	--	--	--	12	5	--	--	256
	2	1	2	--	--	--	--	59	94	--	--	--	--	--	--	--	--	--	--	3	5	--	--	63
	3	--	--	--	--	--	--	281	97	--	--	--	--	--	--	--	--	2	1	3	1	2	1	288
	4	19	2	1	<1	--	--	1,006	97	--	--	--	--	--	--	--	--	--	--	15	1	1	<1	1,042
	5	--	--	1	<1	--	--	204	96	--	--	--	--	--	--	--	--	2	1	5	2	1	<1	213
	6	--	--	2	<1	1	<1	973	98	--	--	--	--	--	--	--	--	--	--	16	2	--	--	992
	7	--	--	--	--	--	--	2	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2
	8	3	<1	4	<1	--	--	825	95	--	--	1	<1	1	<1	2	<1	3	<1	26	3	--	--	865
	9	1	10	--	--	--	--	--	--	--	--	--	--	--	--	1	10	8	80	--	--	--	--	10
	10	15	<1	9	<1	--	--	4,871	98	--	--	--	--	1	<1	--	--	1	<1	77	2	--	--	4,974
	11	1	<1	1	<1	--	--	347	97	--	--	--	--	--	--	--	--	--	--	9	3	--	--	358
	12	13	1	2	<1	--	--	872	93	--	--	3	<1	--	--	43	5	--	--	2	<1	1	<1	936
25330	1	15	<1	6	<1	1	<1	1,132	94	--	--	--	--	4	<1	1	<1	1	<1	33	3	8	1	1,201
	2	2	<1	2	<1	--	--	433	95	--	--	--	--	--	--	--	--	--	--	19	4	--	--	456
	3	3	1	2	1	--	--	219	88	--	--	--	--	--	--	--	--	--	--	25	10	1	<1	250
	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	50	--	--	1	50	2
25333	All	--	--	3	2	--	--	118	88	--	--	--	--	2	1	--	--	5	4	5	4	1	1	134
25480	1	11	2	2	<1	--	--	667	96	--	--	--	--	--	--	--	--	4	1	9	1	--	--	693
	2	3	<1	--	--	1	<1	1,036	98	--	--	--	--	--	--	--	--	1	<1	11	1	2	<1	1,054
	3	3	<1	1	<1	--	--	1,050	95	--	--	--	--	--	--	1	<1	5	<1	44	4	3	<1	1,107
	4	5	1	2	<1	--	--	622	93	--	--	--	--	--	--	--	--	2	<1	36	5	--	--	667
	5	1	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	100	--	--	--	--	3
25532	1	2	2	3	2	--	--	105	79	--	--	--	--	8	6	1	1	1	1	13	10	--	--	133
	2	--	--	--	--	1	3	36	95	--	--	--	--	1	2	--	--	--	--	--	--	--	--	38
	3	5	3	1	1	--	--	145	89	--	--	--	--	3	2	2	2	1	1	7	4	1	1	165
	4	4	3	1	1	--	--	136	86	--	--	--	--	3	2	1	1	--	--	13	8	--	--	158
	5	--	--	1	4	--	--	21	78	--	--	--	--	1	4	--	--	--	--	4	15	--	--	27
	6	5	1	--	--	2	<1	433	92	--	--	--	--	4	1	3	1	--	--	25	5	--	--	472
27002	All	6	1	1	<1	--	--	431	96	--	--	--	--	--	--	--	--	2	<1	10	2	1	<1	451
27004	1	--	--	--	--	--	--	131	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	131
	2	8	5	--	--	--	--	137	93	--	--	--	--	--	--	--	--	--	--	1	1	1	1	147
	3	--	--	--	--	--	--	22	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22

Table 6.66 (Continued).

Site #	Provenience	Biface #	Biface %	Core #	Core %	Drill #	Drill %	Flake #	Flake %	Graver #	Graver %	Knapper #	Knapper %	Large Angular Debris #	Large Angular Debris %	Miscellaneous #	Miscellaneous %	Projectile Point #	Projectile Point %	Small Angular Debris #	Small Angular Debris %	Uniface #	Uniface %	Total
27018	1	--	--	--	--	--	--	300	96	--	--	--	--	--	--	--	--	2	1	10	3	--	--	312
	2	2	<1	1	<1	--	--	504	94	--	--	--	--	1	<1	4	1	--	--	22	4	1	<1	535
	3	7	2	--	--	--	--	362	91	--	--	--	--	1	<1	3	1	3	1	21	5	--	--	397
	4	12	1	--	--	1	<1	1,023	93	1	<1	--	--	4	<1	2	<1	3	<1	49	4	--	--	1,095
	5	3	2	2	1	--	--	138	93	--	--	--	--	--	--	--	--	1	1	5	3	--	--	149
	6	9	2	--	--	--	--	566	96	--	--	--	--	--	--	--	--	--	--	11	2	1	<1	587
	7	--	--	--	--	--	--	120	99	--	--	--	--	--	--	--	--	--	--	1	1	--	--	121
	8	--	--	--	--	--	--	10	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10
27020	1	4	2	3	1	1	<1	229	95	--	--	--	--	1	<1	--	--	3	1	1	<1	--	--	242
	2	--	--	1	13	--	--	7	88	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8
	3	--	--	--	--	--	--	4	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4
	4	2	2	5	4	--	--	100	89	--	--	--	--	--	--	--	--	3	3	2	2	1	1	113
27041	1	3	2	1	1	--	--	119	94	--	--	--	--	--	--	--	--	--	--	4	3	--	--	127
	2	14	1	--	--	--	--	908	93	--	--	--	--	--	--	--	--	3	<1	49	5	2	1	976
	3	--	--	1	2	--	--	52	98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	53
27042	1	1	2	--	--	--	--	41	91	--	--	--	--	--	--	--	--	--	--	3	7	--	--	45
	2	--	--	--	--	--	--	50	91	--	--	--	--	--	--	--	--	1	2	3	5	--	--	55
	3	--	--	--	--	--	--	93	95	--	--	--	--	--	--	--	--	--	--	5	5	--	--	98
	4	2	3	--	--	--	--	63	88	--	--	--	--	1	1	--	--	1	1	5	7	--	--	72
	5	3	2	--	--	--	--	130	94	--	--	--	--	--	--	--	--	--	--	5	4	--	--	138
	6	--	--	--	--	--	--	33	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	33
	7	--	--	--	--	--	--	9	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9
	8	--	--	--	--	--	--	19	95	--	--	--	--	--	--	--	--	--	--	1	5	--	--	20
	9	3	43	--	--	--	--	2	29	--	--	--	--	--	--	--	--	2	29	--	--	--	--	7
51698	1	2	2	1	1	--	--	114	88	2	2	--	--	--	--	--	--	4	3	6	5	2	2	131
51699	All	--	--	2	8	--	--	18	72	--	--	--	--	1	4	1	4	--	--	3	12	--	--	25
51700	1	3	2	1	1	--	--	154	92	--	--	--	--	--	--	--	--	1	1	8	5	--	--	167
	2	1	<1	--	--	--	--	194	95	--	--	--	--	--	--	2	1	--	--	8	4	--	--	205
	3	4	1	--	--	1	<1	510	96	--	--	--	--	--	--	--	--	3	1	13	2	--	--	531
	4	--	--	--	--	--	--	59	97	--	--	--	--	--	--	--	--	--	--	2	3	--	--	61
	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	100	--	--	--	--	1
51701	1	1	1	1	1	--	--	116	91	--	--	--	--	--	--	--	--	--	--	9	7	--	--	127
	2	--	--	1	1	--	--	60	83	--	--	--	--	2	3	2	3	1	1	7	10	--	--	73
51702	All	3	1	3	1	--	--	433	95	--	--	--	--	6	1	--	--	--	--	9	2	--	--	454

Table 6.66 (Continued).

Site	Prove-	Biface		Core		Drill		Flake		Graver		Knap-per		Large Angular Debris		Miscel-laneous		Projec-tile Point		Small Angular Debris		Uni-face		
#	nience	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	Total
51703	1	6	2	1	<1	--	--	280	93	--	--	--	--	6	2	--	--	1	<1	6	2	--	--	300
	2	5	1	1	1	--	--	345	89	1	1	--	--	3	1	--	--	--	--	33	9	--	--	388
	3	2	1	1	<1	--	--	337	92	--	--	--	--	9	2	--	--	--	--	18	5	1	<1	368
	4	4	2	2	1	--	--	170	90	--	--	--	--	4	2	1	1	--	--	7	4	--	--	188
	5	1	<1	1	<1	--	--	201	92	--	--	--	--	4	2	1	<1	--	--	9	4	1	<1	218

Grinding activities occurred at eight sites. As Table 6.67 shows, these activities were most intense at LA 25480 (five mano fragments), LA 25532 (four manos or indeterminate ground stone), and LA 51698 (four slab metate or grinding slab fragments). Of the 19 ground stone items, 13 were manos and five were metates or grinding slabs. Only three pieces were complete. Materials were quartzite and quartzitic sandstone of varying coarseness. Most of the tools were Archaic-type grinding implements, made on cobbles, usually ground on only one side, and only rarely worn down to a flat or concave surface. Only one item, a slab metate fragment from LA 51698, was ground on both sides. Only two items were burned. The three sites with four or more ground stone items all have Piedra Lumbre Phase or later Historic Period occupations, indicated by a Llano Piedra Lumbre structure, Valdito or Penasco Micaceous sherds, a gun flint, and C-14 dates. While associations of ground stone with later components cannot be proven, these data support increased grinding activities during historic as opposed to prehistoric occupations at Abiquiu Reservoir.

6.20.5 Platform Type and Flake Type

A number of subjective flake categories were used to identify flake type to expedite the rough sort analysis and to try to classify flakes that lacked platforms. These classifications were based on a polythetic set of attributes (Acklen 1984:5-6) and included biface flakes, core flakes, uniface flakes, and unknown flakes. The attributes that were used to classify flake type included retouched platforms, lipped platforms, dorsal scars, flake curvature, thickness, edge outline, and the degree to which the platform was pronounced. In general, biface flakes were classified on the basis of platform, thinness, curvature, and dorsal scars. When flakes lacked a platform, they had to exhibit characteristic curvature and dorsal scars to be monitored as biface flakes. As a result a larger number of thin flakes was classified as "unknown flakes" due to the lack of characteristic dorsal scar pattern and the lack of distinctive curvature. Core flakes on the other hand were generally classified on the basis of dorsal cortex and thickness.

Because biface and core flakes were in part classified on the basis of thickness, one would expect mean thicknesses to correlate with flake type. An examination of mean thickness for various flake types and corresponding student's t tests indicates that this is the case. Core flakes exhibit a greater mean thickness than biface and uniface flakes.

T tests indicate that there is a significant difference among all flake classes. One would expect the clear difference between core flakes and biface flakes (B), but it is unclear why biface flakes and uniface flakes (C) are significantly different from one another. One possibility is that the class of uniface flakes does not always represent uniface manufacturing and therefore results in thicknesses that are significantly different. The category of uniface flakes includes a flake type that does not necessarily represent unifacial tool manufacture. These uniface flakes exhibit retouched platforms, and generally the dorsal surface is a single facet. This morphology is the reverse of what is expected on flakes resulting from uniface manufacture or resharpening. It is unclear what these flakes represent. Uniface flakes on the other hand generally exhibit single-faceted platforms, which produce a characteristic edge angle, and parallel dorsal scars originating from the

Table 6.67 Ground Stone Summary, Abiquiu Archaeological Study, ACOE, 1989.

Site	NGrid	EGrid	Type	Portion	Material	Grinding Face Shape	Condition	LxWxT (mm)
LA 25328	88	101	One-hand mano	Complete	Coarse quartzite	Convex	Burned	95 x 71 x 52
LA 25330	129	130	One-hand mano	Fragment	Fine quartzitic sandstone	Convex	--	100 x 89 x 38
LA 25480	362	299	Indet. mano	Fragment	Coarse quartzitic sandstone	Convex	--	145 x 96 x 38
	393	304	Indet. mano	Fragment	Medium quartzitic sandstone	Convex	Burned	72 x 50 x 45
	396	335	Indet. mano	Fragment	Coarse quartzite	Convex	--	34 x 30 x 13
	399	303	Indet. mano	Fragment	Medium quartzite	Convex	--	65 x 43 x 23
	399	302	Indet. mano	Fragment	Medium quartzite	Convex	--	102 x 65 x 38
LA 25530	127.95	111.83	One-hand mano	Complete	Fine quartzite	Convex	--	103 x 87 x 44
LA 25532	115	129	Indet. mano	Fragment	Medium quartzite	Convex	--	64 x 55 x 25
	116	121	Indet. mano	Fragment	Medium quartzitic sandstone	Convex	--	94 x 53 x 39
	256	116	Indet. grnd. stn.	Fragment	Coarse quartzite	Plano	--	54 x 43 x 13
	113	128	Indet. mano	Fragment	Coarse quartzite	Convex	Burned	56 x 48 x 22
LA 27018	101	108	Indet. mano	Fragment	Coarse quartzite	Convex	--	38 x 29 x 14
LA 51698	103	89	Slab metate	Fragment	Medium quartzitic sandstone	Plano	--	395 x 143 x 42
	96	96	Grinding slab	Fragment	Fine quartzitic sandstone	Plano	--	350 x 283 x 18
	104	90	Grinding slab	Fragments (2)	Medium quartzitic sandstone	Plano	--	114 x 52 x 16, 85 x 72 x 16
	--	--	Slab metate	Fragment	Medium granite	Biconcave	--	156 x 165 x 24
LA 51701	99	123	Indet. metate	Fragment	Coarse quartzite	Concave	--	109 x 103 x 54
LA 51703	104.70	81.30	One-hand mano	Complete	Medium quartzitic sandstone	Convex	--	[illegible] x 65 x 45

remnant edge margin on the platform. As the uniface is manufactured, all platforms are single-faceted. In the future these types of platforms should be examined separately, and technological studies should be developed to identify the manufacturing techniques that produce them.

An examination of the mean thickness of "unknown flakes" suggests that they are more similar to biface flakes than core flakes (Table 6.68). In fact the mean thickness is less than that identified for biface flakes and is significantly different at the 0.01 level (A). This significant difference can probably be attributed to a bias in thickness measurements. Thickness measurements were generally taken along the proximal/distal axes of flakes. A large portion of "unknown flakes" consists of flake fragments which not only lack platforms that would aid in their classification as biface flakes but also lack the curvature that is distinctive of many biface flakes. Because only a portion of the flake remains, fragments are flatter, and measurements are consistently thinner. Therefore, flakes that have been classified as "unknown flakes" probably represent formal tool manufacturing debris.

Table 6.68 Flake Type and Thickness, Abiquiu Archaeological Study, ACOE, 1989.

Flake Type	Mean Thickness	Standard Deviation
Unknown	2.78	1.42
Biface	3.02	1.65
Core	6.94	3.67
Uniface	3.55	1.56

"T" Test

Comparison	t Value	Significance Level
(A) Flake Unknown to Biface Flake	2.6	0.01
(B) Core Flake to Biface Flake	26.3	0.0001
(C) Uniface Flake to Biface Flake	3.8	0.01

It was necessary to correlate thickness and flake types with an objective attribute clearly representative of the biface flakes and core flakes to determine if the subjective categories discussed above are in fact reliable. Platform type was selected as an attribute to distinguish between core flakes and biface flakes.

Flakes with platforms were examined to determine if the subjective categories used to classify flakes were valid. Flakes with retouched platforms are viewed as generally representing formal tool manufacture or the production of unifacial and bifacial tools. Retouched platforms can also result from bifacial core reduction; however, platforms are larger, and overall flake thickness is greater. Flakes with cortical or faceted platforms are viewed as representing core reduction. If faceted platforms represent core reduction

and retouched platforms represent formal tool manufacture, one would expect formal tool manufacturing flakes to be thinner than core flakes.

An examination of platform types and mean thickness indicates that there is a significant difference between the thickness of flakes with faceted platforms (core flakes) and flakes with retouched platforms (biface flakes). Core flakes (single-faceted and multifaceted) exhibit greater mean thicknesses than formal tool manufacturing flakes (unidirectional and bidirectional retouch). Core flakes exhibit mean thickness of 5.51 mm (single-faceted platform) and 5.15 mm (multifaceted platform) while formal tool manufacturing flakes exhibit means of 3.32 mm and 3.04 mm (bidirectional retouch). When the mean thicknesses of flakes with collapsed platforms are examined, they are more similar to biface flakes than core flakes. These data suggest that many of these flakes result from formal tool manufacture. The mean thickness for flakes with cortical platforms (7.62 mm) is similar to core flakes, as would be expected.

The "T" tests support the hypothesis that formal tool manufacturing flakes will result in significantly thinner flakes than core reduction. Flakes with single-faceted and multifaceted platforms, which are both viewed as core flakes, were first examined ([A] in Table 6.68). The "T" test indicates that there is no significant difference between these two flake types. Flakes with unidirectionally and bidirectionally retouched platforms, which are both viewed as formal tool manufacturing flakes, were then examined ([B] in Table 6.68). Again, as expected, the "T" test indicates that no significant difference exists. These data indicate that within classes of core flakes and biface flakes there is no significant thickness difference.

When comparisons are made between classes of core flakes and formal tool manufacturing flakes ([C] in Table 6.68), significant thickness differences are identified. These data indicate that flake thickness is a valid criterion for distinguishing between formal tool manufacturing flakes and core flakes. Further, the differences support the subjective flake type classifications that were previously discussed. The mean thicknesses of flakes with retouched platforms (Table 6.69) are similar to the mean thicknesses of biface and uniface flakes (Table 6.68) while the mean thicknesses of faceted flakes (Table 6.69) are similar to the mean thicknesses of core flakes (Table 6.68).

In summary, the data presented above indicate that platform is a statistically valid criterion to classify core flakes and formal tool manufacturing flakes. The data also suggest that a polythetic set can be used reliably to make this same distinction. Finally, these data suggest that flake thickness is an attribute that can be used reliably to distinguish between core reduction flakes and formal tool manufacturing flakes. These data indicate that thickness measurements may provide an objective criterion that can be used to quickly classify reduction variability.

Table 6.69 Platform/Retouch Type and Thickness, Abiquiu Archaeological Study, ACOE, 1989.

Platform or Retouch Type	Mean Thickness	Standard Deviation
Cortical Platform	7.62	4.40
Collapsed Platform	3.58	2.41
Single-Faceted Platform	5.51	13.98
Multifaceted Platform	5.15	32.99
Unidirectional Retouch	3.32	2.94
Bidirectional Retouch	3.04	1.87

"T" Test

Comparison	t Value	Significance Level
(A) Single-Faceted and Multifaceted Platforms	1.5	0.25 Not Significantly Different
(B) Unidirectional Retouch and Bidirectional Retouch Platforms	1.63	0.15 Not Significantly Different
(C) Multifaceted Platforms and Bidirectional Retouch Platforms	5.6	0.01
(D) Collapsed Platforms and Bidirectional Retouch Platforms	2.39	0.02

PART III

SPECIALIZED STUDIES

7.0 THE ABIQUIU OBSIDIAN HYDRATION STUDY: ITS IMPLICATIONS FOR THE ABIQUIU AREA AND FOR ARCHAEOLOGICAL METHODS AND ANALYTICAL TECHNIQUES

Jack B. Bertram

7.1 INTRODUCTION

The archaeological assemblages studied at Abiquiu were generally characterized by unusually high frequencies of obsidian tools and debitage, in comparison with assemblages from most other areas of New Mexico. The richness of obsidian assemblages collected made it feasible and desirable to exploit the potential of obsidian hydration analysis for spatial, typological, and chronometric analyses; special emphasis on obsidian hydration and sourcing, intrasite spatial analysis, and typological chronometry was also required by the contractual agreement between MAI and ACOE which led to the Abiquiu study.

7.2 OBSIDIAN HYDRATION ANALYSIS - THE BACKGROUND

Beginning with the landmark studies of Friedman and Smith (1958, 1960), obsidian hydration has assumed steadily increasing importance in archaeological research.

Obsidian refers to a wide range of mostly rhyolitic, extrusive, igneous rock glasses displaying variable transparency and essentially perfect aplanar or conchoidal fracture due to their lack of crystalline structure. Obsidians are produced when fluid volcanic ejecta are supercooled by contact with wet soil, water, snow, or very cold air. Obsidians, although relatively soft and brittle, are eminently knappable.

Hydration on obsidian surfaces occurs as gaseous water diffuses into the surface region of freshly broken obsidian. The rate at which hydration occurs is primarily influenced, in ways not yet fully understood, by the presence in the obsidian of feldspar inclusions (Erickson et al. 1975, Laursen and Lanford 1978), by the chemical composition of the obsidian matrix (Friedman and Long 1976; Taylor 1976; Michels and Tsong 1980; Michels 1984a, 1984b, 1984c, 1985a, 1985b, 1985c; Michels et al. 1983), and by the temperature history of the artifact being studied (Ambrose 1976, Michels et al. 1983, Michels and Tsong 1980, Friedman and Long 1976).

Early in the development of obsidian hydration studies, this causal complexity was poorly appreciated; as a result, obsidian hydration dating was judged to be of primary value as a relative chronological resource, to be calibrated by association with adiocarbon, dendrochronological, or other absolute chronometric sources.

Improvements in technology have made possible a partial explication of the physics and chemistry of hydration, as well as making feasible repeated <u>induced</u> hydration studies (Michels and Tsong 1980, Michels et al. 1983). Christopher Stevenson has been working on an induced hydration approach since 1976. This method hydrates samples from selected obsidian flows at elevated temperature under steam pressure for periods of up to three years (Stevenson

and Scheer 1989). It is now clear that induced obsidian hydration analysis can provide rather accurate absolute chronometric data, provided that: 1) the temperature histories of the dated objects are correctly reconstructed; 2) the geochemical sources of the objects are accurately determined and relatively homogeneous; 3) the objects are examined at enough loci to ensure that both the initial production event and any later recycling events are detected; and 4) the object's history does not include events which have resulted in undetectable destruction of its surface.

Each of these assumptions must be carefully examined if an attempt to date an object is to be reliably accurate. These assumptions are discussed in greater detail below with particular reference to the Abiquiu Reservoir data set.

7.2.1 Temperature

Obsidian hydrates according to a diffusion process characterizable by the Arrhenius diffusion equation (Michels 1984a:3) most clearly expressed as:

$$x^2 = kt \qquad (1)$$

where x is the thickness of the hydration layer, k is the hydration rate, and t is the time. The hydration rate is temperature-dependent and follows the Arrhenius equation given by:

$$k = Ae^{-E/RT} \qquad (2)$$

or (as an estimate)

$$k' = k \exp \left(E/R \left(\frac{1}{T} - \frac{1}{T'}\right)\right) \qquad (3)$$

where

k = experimentally induced hydration rate in $u(microns)^2$/day @ T(temperature) for the material in question

k' = unknown (hydration rate @ T')

A = hydration constant

E = experimentally determined activation energy in J(joule)/mol(molecule) for the material in question.

R = 8.317 $J/mol^{-1}{}^{o}C^{-1}$ (gas constant)

T = $473.16^{o}K$ ($200^{o}C$)

$T' = T_e$ (effective hydration temperature in ^oK for the archaeological site to be dated) $T_e(^oK) = T_e(^oC) + 273.16$.

thus

$$k' = 7.48 \exp \left[\frac{77251}{8.317} \cdot \left(\frac{1}{473.16} - \frac{1}{T'}\right)\right] \qquad (4)$$

$k' \cdot 365.36 \cdot 1{,}000$ = rate expressed as $u^2/1{,}000$ years.

It is clear from equation 2 that the hydration rate varies rapidly with relatively minor changes in temperature. As Friedman and Long (1976:348) point out:

> An obsidian exposed to atmospheric temperature, either by being at the surface or buried in the ground at very shallow depth (~1 to 10 cm), will experience wide diurnal temperature fluctuations. Since the hydration rate varies as a power function of the temperature and not linearly, an average or mean temperature cannot be used to calculate a rate. Instead, Eq. 2 must be solved for *k* using a temperature that has acted for a small time interval, and then all the *k*'s must be averaged to get an average rate for the total time.
>
> In contrast, an obsidian that has been buried sufficiently deep that the diurnal temperature wave is damped out will be exposed to attenuated seasonal temperature variations, or even to a steady temperature. A single temperature can then be used to determine an average rate. The depths of burial to yield these conditions vary with soil diffusivity, albedo, snow cover, climate, and so forth, but usually samples buried to depths of at least 1.0 m will experience an extremely small seasonal variation; samples buried to depths of 0.5 m will experience almost no diurnal variation and a seasonal variation that is about one-third the variation of the average air temperature.

Friedman and Long (1976:348-351) report confirmation of these expectations through experimental thermal monitoring of obsidian in shaded air, obsidian exposed to the sun on the soil surface, and obsidian buried at various depths. Mean annual temperatures for their United States sites varied as much as 18^{o}C between in-sun and buried loci; consequently, hydration rates (expressed as $u^2/1{,}000$ years) varied by a factor of five to six. They caution that surficial or shallowly buried obsidian will hydrate far faster or slower than might be expected from calculation of mean air temperature, particularly in northerly settings where winter snow cover is extensive. It should be noted that this problem may be expected to be extreme in high elevation settings where insolation is especially effective and where minor variations in

slope, exposure, and cover can produce major variations in surface and subsurface microclimate. For example, where shaded northerly slopes hold snow for long periods, much lower temperatures are to be expected, both in the soil and in the soil-surface boundary air layer, relative to less vegetated and more southerly exposures close by.

The power function relationship between temperature and hydration rate also ensures that those obsidian items formerly selected most often for calibration with associated hearth charcoal will produce the least reliable rate estimates. Polvadera obsidian held at 200°C for 24 hours will hydrate as much as will obsidian held for 1,000 years at 14°C, the effective hydration temperature at Abiquiu, a difference in rate of a factor of 365,000. At 150°C, the accumulation of Polvadera rind thickness equivalent to 1,000 years of in-field normal hydration requires 10 days, a difference in rate due to temperature of a factor of 36,500 (Michels 1984a:1). These rate differences imply that even very short-term thermal exposure, such as burial adjacent to a roasting pit, or surface exposure to a forest fire, will greatly increase the apparent age of an object.

7.2.2 Rind Stability

Error due to rind instability must be anticipated for most southwestern archaeological obsidian. Obsidian buried in trampled areas will lose some rind thickness due to soil abrasion (Behrensmeyer and Hill 1980) as will surface obsidian exposed to sandblasting, flow abrasion by sand-water slurries, or transport abrasion and tumbling from actual movement downslope. Thermal effects and abrasion effects may thereby confound one another, especially for objects exposed on southerly slopes.

7.2.3 Sourcing

Errors of both systematic and random kinds can arise from the linked assumptions that obsidian has been correctly sourced and that a single source is absolutely homogeneous. The latter assumption is clearly incorrect; zinc concentrations, for example, within the MAI/ACOE Abiquiu samples vary from 30.8 to 69.5 ppm for Cerro del Medio (Appendix A). Other elements whose concentrations were determined vary to a similar degree within a supposedly homogeneous source. The importance of this intrasource variability is not yet understood; further research into the interaction of major constituents and trace elements in determining hydration rates is needed (Friedman and Long 1976:347, Michels and Tsong 1980:429, Friedman and Trembour 1978:545) as minor trace element or major constituent concentration shifts can, in theory, produce major inhibiting or facilitating changes in the hydration process.

7.2.4 Recycling

Readings taken on deliberate or natural breakage occurring substantially later than an original reduction event will result in incorrect dating of the initial event. To prevent this, it is necessary to check rind thicknesses at several points on a sample; it is advisable to take several samples from each artifact and to determine rind thickness for every sample on at least two scar

surfaces, on dorsal and ventral flake faces, or on obverse and reverse sides of bifaces.

Especially in the case of large flakes, cores, and formal tools, repeated scavenging, reuse, and disposal cycles may extend the use life of an item by perhaps thousands of years. In these cases, special care must be taken to detect episodes of recycling; earlier episodes thus dated should not be assumed to pertain to the locus at which the artifact was finally discarded.

7.3 APPROACHES TO THE ABIQUIU OBSIDIAN STUDIES

The potential for using relative obsidian hydration dating as a tool for temporal disaggregation of assemblages was anticipated by Clark (1961a, 1961b) and by Michels (1965a, 1965b) in pioneering site studies; later, chronometric studies reinforced archaeologists' expectations that obsidian analysis would eventually permit

> archaeologists to associate artifacts with one another for the purpose of forming artifact complexes in the absence of reliable stratigraphy. For the first time, there exists a perfectly unbiased procedure for segregating surface material, and materials from poorly stratified or unstratified sites, into analytically useful units of association (Michels and Tsong 1980:411).

In New Mexico, pioneering efforts to exploit this potential using sourced, induced hydration were carried out by Kauffman (1984) and Batcho (1984). Kauffman's study of the Vista Hills Site obsidian assemblage revealed that an apparently simple site was in fact composed of PaleoIndian, Archaic, Formative, and perhaps Historic components; she found that subsurface loci of apparently high integrity were actually recycled or mixed assemblages. Batcho's study determined that the Grants Prison Sites, the sites at which the San Jose Archaic Complex was defined, were composed of numerous spatially overlapping occupations of different ages; his report indicated that sourcing hydration studies could realistically be used to disarticulate deflated or mixed sites.

The approach to obsidian analysis employed in the MAI-ACOE study drew heavily on Batcho's and Kauffman's strategies and recommendations; also valuable were the discussions with personnel who had been involved in the CCP-ACOE Abiquiu study regarding their experience with Abiquiu obsidian assemblages. Especially helpful in this regard were W. Whatley, J. Rancier, and K. Lord (personal communication 1985), whose procedures for selection of cut locations were adopted with modification. These procedures, together with major aspects of MAI's obsidian analytical strategy, are detailed below.

Obsidian items having direct chronometric value occur in the Abiquiu sites in a variety of forms. Among these are:

- Projectile points.

- Bifaces.

- Unifaces.

- Cores.

- Debitage.

Projectile points are potentially informative for several reasons:

1. Projectile points commonly serve as *fossils directeurs*; the temporal range of manufacture of most types is inadequately known. Especially at Abiquiu Reservoir, chronology of obsidian projectile types clearly required further study along the lines of the work begun by CCP (Lord and Cella 1986).

2. A projectile point may be manufactured from an earlier projectile point or other item, resulting in a substantial modification of its original typology.

3. Projectile points and their fragments may be recycled, either as other tools or as modified projectile points. This recycling can occur immediately after initial discard, or it can occur thousands of years later.

Consequently, a projectile point may display differing hydration on different areas of its surface reflecting the:

- Date of blank production.

- Date of haft production.

- Date of haft modification.

- Date of blade shaping.

- Date of blade modification.

- Date of breakage.

- Date of edge or break reuse.

Like projectiles, other obsidian items may display evidence of multiple discard and reuse cycles; these may be identified directly from hydration if enough time elapsed between use episodes. Special attention was thus paid to ensure that cuts monitored possible differences in weathering between dorsal and ventral flake surfaces, or between tool surfaces and breakage surfaces. Conversely, in attempting to date clusters of items thought to be produced by single reduction episodes, MAI took special care to ensure that surfaces generated <u>during</u> a reduction episode were dated (e.g., interior breaks, distal edges of convergent flake scars, etc.). Items chosen for dating of reduction episodes were selected from near the centers of suspected obsidian debitage concentrations to increase the probability that the item dated was not intru-

sive to the episode's debris. Similarly, multiple items from a concentration were dated whenever possible to determine if the concentration reflected multiple reduction episodes which occurred over a wide time range. In no case was sampling random; for debitage, randomness was approximated.

7.3.1 Obsidian Hydration Study - Methods and Priorities

Immediately after washing was complete, detailed analysis of formal obsidian tools began, as did illustration of these items. Exact illustrations were used to indicate the precise locations of desired cuts and readings, to ensure that the resulting hydration dates were interpretable as production, modification, or recycling dates. These illustrations are referenced for the reader's benefit during the discussion of points from each site in section 7.5, but the figures are presented in Chapter 8, where the points are discussed in depth.

Nondiagnostic flakes and small angular debris were routinely set aside from all obsidian-rich proveniences as artifact washing proceeded. These debitage samples provided hydration data for determining the spatial homogeneity and richness of obsidian clusters; they also provided the population from which most debitage hydration samples were drawn.

Priority allocation of samples for hydration dating emphasized, in descending priority order:

1. Haft dates for formal tools.

2. Production dates for debitage concentrations.

3. Dating of obsidian associated with C-14 dates.

4. Reworking dates for tools which appeared, on the basis of weathering, to have been recycled long after their first abandonment.

5. Reworking dates for tools where reworking may have substantially modified typology or function.

6. Production dates for nondiagnostic bifaces and unifaces.

7. Recycling or original dates for nondiagnostic bifaces, unifaces, and pieces of debitage exhibiting ventral scars substantially fresher than dorsal scars.

8. Dating of obsidian from subsurface contexts or from sites having only sparse obsidian.

9. Redundant dates on tool hafts or debitage scatters, to ensure the possibility of statistical assessment of dating consistency.

7.3.2 Obsidian Hydration Dating - Samples

Based on the initial inventory of Abiquiu Project collections, it was decided to submit 248 specimens for sourcing and dating; initial analysis suggested the need for multiple readings for at least 45 of these specimens.

Rind determinations were carried out by the Obsidian Hydration Dating Laboratory, Cultural Resources Management Division, New Mexico State University, under the direction of Dr. Christopher M. Stevenson (Appendix B). Stevenson arranged for sourcing analysis of all specimens to be carried out by the Anthropological Studies Center, Sonoma State University Academic Foundation, Inc., under the direction of Dr. Richard E. Hughes (Appendix A).

Stevenson determined that a substantial portion of the debitage items originally submitted was too small to permit both hydration measurement and destructive sourcing; additional items were selected from nearby loci to replace the flakes and angular fragments thus rejected. In general, Stevenson took simultaneous, multiple readings for flakes and tools on both dorsal and ventral hydration; for angular debris and end-snapped tools, both a tool surface and the adjacent snap surface were generally read. For edge worn, edge ground, or retouched items, efforts were made to measure rind thickness on wear surfaces and on adjacent unworn surfaces. Where these adjacent or opposed surfaces differed significantly in hydration degree, they were reported separately, as if two separate slices had been taken.

As Stevenson's hydration induction studies were not completed as of this writing, he elected to <u>infer</u> hydration rates for the sources reported by Hughes to be present in the assemblage studied, using the "chemical index" rate graph sheaf reported by Friedman and Long (1976) and the weather data for Abiquiu Dam reported by Lord and Cella (1986). Tables B.2A and B.2B in Appendix B report these dates using a 10.40 um^2/1,000 years rate for Polvadera. Table B.2C uses an 11.5 um^2 rate for Obsidian Ridge samples.

It is the author's belief that the Friedman-Long rates thus estimated are unrealistically high; it has therefore been decided to accept Stevenson's hydration rind measurements and Hughes' source analyses, but to employ the rates for induced hydration reported by Michels (1984a, 1984b, 1984c, 1985a) and summarized by CCP (Lord and Cella 1986). These dates are evaluated and summarized in this chapter.

After the first draft of this chapter was written, Stevenson completed induced hydration studies on Polvadera and Obsidian Ridge sources. The new rates, 8.81 um^2 for Polvadera and 7.83 um^2 for Obsidian Ridge, produce dates that vary by five percent from the rates used by Bertram in writing this chapter. The difference amounts to less than 50 years for post-Developmental Periods and less than 200 years for the San Jose Phase. The least difference is five years for a rind measuring 0.94 microns, and the greatest difference is 389 years for a rind of 8.27 microns (7,763 years B.P.). Figure H.1 in Appendix H shows the effect in terms of number of years' difference for the Bertram and new rates. The discrepancy between dates produced by the two rates is greater for older dates than for more recent dates. Since the time spans for the Oshara Tradition phases are longer than those for the later Rio

Grande or Pecos classifications, however, the date differences are not considered significant enough to affect this chapter's results, given the broad scale of the analysis. The grouped dates used only in this chapter are based on Michels' 8.39 um^2 and 7.37 um^2 rates. The dates based on 8.81 um^2 and 7.83 um^2 are presented in Appendix H and discussed in Chapter 8.

Stevenson has not produced an induced hydration rate for Cerro del Medio; in the absence of such an estimate, Stevenson advised against estimating this value except where reliable cross-dates were available. Unfortunately, the multicomponent nature of the 18 Abiquiu sites does not make the use of temporal cross-checks reliable. Consequently, no dates for Cerro del Medio artifacts have been estimated except in the present chapter. Cerro del Medio obsidian was submitted for half of the sites: LA 25328 (15 items), LA 25330 (1), LA 25333 (1), LA 25480 (6), LA 25532 (1), LA 27002 (1), LA 27018 (2), LA 51698 (5), and LA 51700 (1). Cerro del Medio contributed more than 10 percent of the dated obsidian in only five cases: LA 25328 (15/72 pieces or 21 percent), LA 25333 (1/5 or 20 percent), LA 25480 (6/47 or 13 percent), LA 27002 (1/9 or 11 percent), and LA 51698 (5/10 or 50 percent). For these five sites, the reader should compare the occupations listed in this chapter using Cerro del Medio dates with the occupations listed in Chapter 8, which do not include Cerro del Medio dates.

It was decided to perform all statistical analyses in this chapter on rind thickness rather than on estimated age -- because age is related to the <u>square</u> of the variable of direct measurement, rind thickness. Moreover, most attritive or confounding phenomena (e.g., abrasion) probably attrite the surface of an obsidian piece linearly; thus the errors induced by measurement are probably linear with rind thickness. It is impossible to construct a single confidence interval for the skewed distribution produced by squaring the approximately normal error distribution on rind thickness; statistical analysis would lead one clumsily to quote a date as, for example, 1,150 B.P. (+250 or -163). Finally, MAI found Michels's rates acceptable for the Polvadera, Cerro del Medio, and Obsidian Ridge/Rabbit Mountain sources because dates inferred by Michels for CCP on small and medium side-notched and corner-notched points using those rates were consistent with existing knowledge regarding the well-dated dart-to-arrow and side-notched-to-corner-notched transitions (Lord and Cella 1986), which appear to have occurred as relatively synchronic technological shifts over much of temperate North America (cf. Bertram and Levine 1983, Earls et al. 1987).

The exhaustive source trace-element analysis carried out by Hughes (Appendix A) together with the observations carried out on major constituent compounds by Michels for CCP (Lord and Cella 1986) confirm the generalization that Jemez obsidian sources, especially Polvadera, are chemically variable and hence will display a range of hydration rates even at fixed temperature and under invariant conditions. The observable distribution of hydration rate variability across an obsidian deposit, across a single cobble, or across an assemblage under study cannot yet be quantified, but rates will be significantly variable within a source insofar as they depend on chemical composition.

The dates presented in this study are based on Michels' 8.39 (this chapter) and Stevenson's 8.81 (Appendix H and Chapter 8) Polvadera and Michels' 7.37 (this chapter) and Stevenson's 7.83 (Appendix H and Chapter 8) Obsidian Ridge induced hydration rates. Only this chapter uses the 3.45 Cerro del Medio hydration rate. Site soil temperatures were extrapolated from air temperature records for the reservoir area. The resulting obsidian dates assume that estimates of archaeological hydration rates and soil temperature are correct. As additional cross-checks on these estimates are performed and the induced hydration method is improved, reported dates are expected to approximate more closely the actual dates of archaeological manufacture or use of obsidian items.

Interpretive approaches adopted in this study were influenced by these findings, as well as by the author's anticipation of variance induced by sun exposure, slope context, burial, and attrition of obsidian. Since it was not possible to determine the range of rind variation to be expected on debitage from a single reduction event, it was assumed that items producing rind thicknesses, from differing faces, varying no more than one-half micron were monitoring essentially synchronous events. Where a single piece produced multiple rind thicknesses differing by more than one-half micron, it was assumed that the earlier (i.e., thicker) rind reflected production, not necessarily at the site of final discard, while the later (i.e., thinner) rind reflected an event related to discard and probably (for debitage and tool fragments, at least) dating the occupation of the locus of final discard. Earlier (thicker) rinds were recorded as <u>recycled</u> dates.

Because it was decided to compare measured rinds rather than calculated ages, it was necessary to transform data so that the rapidly hydrating Polvadera pieces could be compared to the very slowly hydrating Cerro del Medio specimens, according to the following computation:

> Assume two sources, S_1 and S_2, hydrating in uniformity at rates V_1 and V_2, for a uniform time T, and having total rind thicknesses accumulated at T of t_1 and t_2, respectively.
>
> Then $t_1^2/V_1 = T$
>
> $t_2^2/V_2 = T$
>
> hence
>
> $$t_1^2 = t_2^2\,(V_1/V_2)$$
>
> $$t_1 = t_2\,\sqrt{V_1/V_2}.$$

This relation can be used to calculate Polvadera equivalent rind thicknesses for measured rind thicknesses of other obsidians. The result is as follows:

Source	V (μm^2/1,000 years)	t (μm) at 1,000 years BP
Polvadera	8.39	$2.897 = \sqrt{8.39}$
Obsidian Ridge	7.37	$0.937\ t_{polvadera} = 2.715$
Cerro del Medio	3.45	$0.64\ t_{polvadera} = 1.858$

Conversely, it is possible to express an Obsidian Ridge or Cerro del Medio rind thickness as the equivalent rind thickness to be expected on a Polvadera fragment hydrating under identical conditions:

Source	t	$t_{polvadera\ equivalent}$
Polvadera	t_p	t_p
Obsidian Ridge	t_o	$t_o(1/0.937)=t_o \cdot 1.067$
Cerro del Medio	t_c	$t_c(1/0.64)=t_c \cdot 1.563$

Using these factors, and assuming that Michels' determinations of rate equation coefficients are at least proportionally correct, it is possible to calculate a Polvadera equivalent rind thickness for Obsidian Ridge and Cerro del Medio obsidian rind measurements; the resultant values permit the use of all rind measurements within a single analysis, without regard to source. The maximum likelihood estimate is then given by

$$\text{years BP} = t_p^2\ (1{,}000/V_p)$$

$$= t_p^2\ (1{,}000/8.39)$$

$$= t_p^2\ (119.19)$$

The resulting Polvadera equivalent rind thicknesses are tabulated, together with standardized provenience and material data, in Table 7.1. A "?" in the Polvadera equivalent and measured rind columns means that the hydration rim could not be measured because the obsidian was either too dark or too crystalline to be seen. The standardized coordinates were derived from a SYSTAT standardization program which scaled the coordinates based on the range of coordinates from all sites. The standardized coordinate scale gives converted distances (all are negative) from an imaginary origin point north and east of the artifact distributions. Thus, the higher the negative number, the closer the artifact is to the southwest corner of the site. The unconverted coordinates refer to square meter collection grids. When rind thickness was variable, sometimes two readings were reported (e.g., CRMD No. 719 on the first page of Table 7.1). Where two or more cuts were made on one artifact, these were given separate CRMD numbers and were noted in Appendix H as C1 (Cut 1), C2, etc. Derivation of dates using Stevenson's Polvadera and Obsidian Ridge induced hydration rates and dates for each artifact are given in Appendix H. Dates for each artifact in Table 7.1 have been calculated using the above formulae. Differences in ages calculated using the formulae directly on measured rim width (as in Table 7.1) as opposed to using standardized

Table 7.1 Obsidian Hydration Results, Proveniences, and Equivalent Rind Thicknesses, Abiquiu Archaeological Study, ACOE, 1989.

CRMD Lab No.	Site (LA No.)	Artif. or Unit No.[1]	North Coordinate	Standardized North Coordinate	East Coordinate	Standardized East Coordinate	Level	Artifact Type	Occupation Dated?	POLEQUI (um)	Actual Measured[2] Rind If Not Polvadera	Material[3] Source	Standardized Polvadera Rind Depth	Obsidian Hydration Date B.P. (8.39 um[2] Pol. Rate)
809	25328	1	--	--	--	--	--	dummy	valid	--	--	P	-2.53	--
867	25328	7	42	-1.16	92	-0.90	--	point	valid	3.15	3.15	P	-0.56	1,183
796	25328	4	43	-1.15	83	-0.99	--	debitage	valid	4.30	4.30	P	0.16	2,204
362	25328	4	44	-1.14	83	-0.99	--	debitage	valid	4.14	4.14	P	0.06	2,043
869	25328	6	44	-1.14	96	-0.85	--	point	valid	5.07	5.07	P	0.64	3,064
361	25328	4	45	-1.13	84	-0.98	--	debitage	reused	4.13	4.13	P	0.05	2,033
361	25328	--	45	-1.13	84	-0.98	--	debitage	valid	3.19	3.19	P	-0.53	1,213
360	25328	4	46	-1.12	84	-0.98	--	debitage	valid	3.10	3.10	P	-0.59	1,145
719	25328	55	52	-1.07	125	-0.54	--	tool	reused	5.27	5.27	P	0.77	3,310
719	25328	--	52	-1.07	125	-0.54	--	tool	valid	3.88	3.88	P	-0.10	1,794
366	25328	3	52	-1.07	153	-0.24	--	debitage	valid	2.87	2.87	P	-0.73	982
789	25328	6	53	-1.07	129	-0.50	1	debitage	valid	4.79	4.79	P	0.47	2,735
741	25328	28	53	-1.07	129	-0.50	1	tool	reused	6.48	4.03	CdM	1.52	4,731
741	25328	--	53	-1.07	129	-0.50	1	tool	reused	5.83	3.63	CdM	1.12	3,832
742	25328	--	53	-1.07	129	-0.50	1	tool	valid	5.22	3.25	CdM	0.74	3,076
742	25328	--	53	-1.07	129	-0.50	1	tool	reused	7.20	4.48	CdM	1.98	5,840
743	25328	--	53	-1.07	129	-0.50	1	tool	reused	5.61	3.49	CdM	0.98	3,540
365	25328	3	53	-1.07	152	-0.25	--	debitage	valid	4.52	4.52	P	0.30	2,435
365	25328	--	53	-1.07	152	-0.25	--	debitage	reused	5.31	5.31	P	0.79	3,361
371	25328	6	54	-1.06	129	-0.50	1	debitage	valid	1.08	1.08	P	-1.86	139
870	25328	19	54	-1.06	153	-0.24	--	point	valid	4.48	4.48	P	0.27	2,392
765	25328	45	55	-1.05	145	-0.32	--	tool	valid	3.04	3.04	P	-0.63	1,102
765	25328	--	55	-1.05	145	-0.32	--	tool	reused	4.72	4.72	P	0.42	2,655
765	25328	--	55	-1.05	145	-0.32	--	tool	reused	3.77	3.77	P	-0.17	1,694
766	25328	--	55	-1.05	145	-0.32	--	tool	reused	3.73	3.73	P	-0.20	1,658
724	25328	13	55	-1.05	150	-0.27	--	tool	valid	3.81	3.81	P	-0.15	1,730
364	25328	3	55	-1.05	152	-0.25	--	debitage	valid	3.39	3.39	P	-0.41	1,370
721	25328	16	55	-1.05	154	-0.23	--	tool	valid	5.03	3.13	CdM	0.62	2,850
363	25328	3	56	-1.04	150	0.27	--	debitage	valid	4.86	4.86	P	0.51	2,815
712	25328	63	56	-1.04	153	-0.24	--	tool	valid	3.54	3.54	P	-0.32	1,494
764	25328	8	58	-1.02	144	-0.34	--	tool	valid	2.59	2.59	P	-0.91	800
720	25328	12	58	-1.02	150	-0.27	--	tool	valid	4.42	4.42	P	0.24	2,329
709	25328	62	58	-1.02	152	-0.25	--	tool	valid	3.46	3.46	P	-0.37	1,427
700	25328	50	60	-1.01	147	-0.30	--	tool	valid	3.22	3.22	P	-0.52	1,236
730	25328	11	60	-1.01	153	-0.24	--	tool	valid	3.40	3.40	P	-0.40	1,378
861	25328	42	69	-0.93	89	-0.93	--	point	reused	10.75	6.69	CdM	4.20	13,040
861	25328	--	69	-0.93	89	-0.93	--	point	valid	6.06	3.77	CdM	1.26	4,135
862	25328	--	69	-0.93	89	-0.93	--	point	valid	6.62	4.12	CdM	1.61	4,943
862	25328	--	69	-0.93	89	-0.93	--	point	valid	6.04	3.76	CdM	1.25	4,121
811	25328	5	80	-0.84	107	-0.73	--	debitage	valid	3.27	3.27	P	-0.48	1,274

Table 7.1 (Continued).

CRMD Lab No.	Site (LA No.)	Artif. or Unit No.[1]	North Coor-dinate	Stand-ardized North Coor-dinate	East Coor-dinate	Stand-ardized East Coor-dinate	Level	Artifact Type	Occu-pation Dated?	POLEQUI (um)	Actual Measured[2] Rind If Not Polvadera	Mate-rial Source[3]	Stand-ardized Polvadera Rind Depth	Obsidian Hydration Date B.P. (8.39 um[2] Pol. Rat.)
801	25328	5	80	-0.84	109	-0.71	--	debitage	valid	4.13	4.13	P	0.05	2,033
863	25328	43	81	-0.83	99	-0.82	--	point	valid	5.09	3.17	CdM	0.66	2,920
864	25328	--	81	-0.83	99	-0.82	--	point	valid	4.98	3.10	CdM	0.59	2,804
358	25328	5	87	-0.78	103	-0.78	--	debitage	valid	3.99	3.99	P	-0.03	1,898
357	25328	5	87	-0.78	109	-0.71	--	debitage	valid	3.82	3.82	P	-0.14	1,739
378	25328	5	88	-0.77	108	-0.72	--	debitage	valid	3.33	3.33	P	-0.45	1,322
377	25328	5	88	-0.77	110	-0.70	--	debitage	valid	3.50	3.50	P	-0.34	1,460
804	25328	5	89	-0.77	110	-0.70	--	debitage	valid	3.23	3.23	P	-0.51	1,243
376	25328	5	89	-0.77	111	-0.69	--	debitage	valid	3.93	3.93	P	-0.07	1,841
810	25328	5	90	-0.76	107	-0.73	--	debitage	valid	3.24	3.24	P	-0.50	1,251
375	25328	5	90	-0.76	109	-0.71	--	debitage	valid	3.35	3.35	P	-0.43	1,338
812	25328	5	90	-0.76	110	-0.70	--	debitage	valid	3.48	3.48	P	-0.35	1,443
374	25328	5	92	-0.74	104	-0.77	--	debitage	valid	3.94	3.94	P	-0.06	1,850
373	25328	5	93	-0.73	101	-0.80	--	debitage	valid	3.54	3.54	P	-0.32	1,494
372	25328	5	93	-0.73	104	-0.77	--	debitage	valid	4.20	4.20	P	0.10	2,103
369	25328	5	95	-0.72	111	-0.69	--	debitage	valid	3.55	3.55	P	-0.31	1,502
370	25328	5	95	-0.72	112	-0.68	--	debitage	valid	2.63	2.63	P	-0.89	824
865	25328	23	97	-0.70	113	-0.67	--	point	valid	6.38	3.97	CdM	1.46	4,596
866	25328	--	97	-0.70	113	-0.67	--	point	valid	6.54	4.07	CdM	1.56	4,821
359	25328	2	105	-0.63	125	-0.54	--	debitage	valid	4.06	4.06	P	0.01	1,965
705	25328	4	105	-0.63	125	-0.54	--	tool	valid	3.70	3.70	P	-0.22	1,632
706	25328	--	105	-0.63	125	-0.54	--	tool	valid	3.80	3.80	P	-0.15	1,721
734	25328	24	107	-0.62	93	-0.89	--	tool	reused	3.26	3.26	P	-0.49	1,267
734	25328	--	107	-0.62	93	-0.89	--	tool	valid	2.54	2.54	P	-0.94	769
868	25328	21	126	-0.46	100	-0.81	--	point	valid	6.78	4.22	CdM	1.72	5,192
747	25328	1	148	-0.28	60	-1.24	--	tool	valid	3.79	3.79	P	-0.16	1,712
808	25328	1	150	-0.26	64	-1.20	--	debitage	valid	3.35	3.35	P	-0.43	1,339
368	25328	1	151	-0.25	58	-1.26	--	debitage	valid	3.75	3.75	P	-0.18	1,676
807	25328	1	152	-0.24	56	-1.28	--	debitage	valid	3.75	3.75	P	-0.18	1,676
806	25328	1	152	-0.24	59	-1.25	--	debitage	valid	3.21	3.21	P	-0.52	1,228
687	25328	3	152	-0.24	61	-1.23	--	tool	valid	3.73	3.73	P	-0.20	1,658
367	25328	1	153	-0.23	55	-1.30	--	debitage	reused	6.08	6.08	P	1.28	4,406
367	25328	--	153	-0.23	55	-1.30	--	debitage	valid	4.06	4.06	P	0.01	1,965
805	25328	1	153	-0.23	62	-1.22	--	debitage	valid	3.40	3.40	P	-0.40	1,378
762	25330	28	100	-0.67	118	-0.62	--	tool	valid	3.41	3.41	P	-0.40	1,386
763	25330	--	100	-0.67	118	-0.62	--	tool	reused	3.97	3.97	P	-0.05	1,879
763	25330	--	100	-0.67	118	-0.62	--	tool	valid	3.42	3.42	P	-0.39	1,394
694	25330	10	103	-0.65	100	-0.81	--	tool	valid	2.68	2.68	P	-0.85	856
695	25330	--	103	-0.65	100	-0.81	--	tool	valid	2.70	2.70	P	-0.84	869
718	25330	36	105	-0.63	104	-0.77	--	tool	valid	9.27	5.77	CdM	3.28	9,697
754	25330	14	106	-0.62	107	-0.73	--	tool	valid	2.53	2.53	P	-0.95	763

Table 7.1 (Continued).

CRMD Lab No.	Site (LA No.)	Artif. or Unit No.[1]	North Coor- dinate	Stand- ardized North Coor- dinate	East Coor- dinate	Stand- ardized East Coor- dinate	Level	Artifact Type	Occu- pation Dated?	POLEQUI (um)	Actual Measured[2] Rind If Not Polvadera	Mate-[3] rial Source	Stand- ardized Polvadera Rind Depth	Obsidian Hydration Date B.P. (8.39 um[2] Pol. Rate)
755	25330	--	106	-0.62	107	-0.73	--	tool	valid	2.76	2.76	P	[illegible]	908
677	25330	31	108	-0.61	115	-0.65	--	tool	valid	4.91	4.91	P	0.54	2,873
339	25330	1	108	-0.61	125	-0.54	--	debitage	valid	4.86	4.86	P	0.51	2,815
686	25330	4	110	-0.59	99	-0.82	--	tool	valid	5.48	5.48	P	0.90	3,579
340	25330	1	117	-0.53	129	-0.50	--	debitage	valid	4.04	4.04	P	--	1,945
337	25330	1	120	-0.51	128	-0.51	--	debitage	valid	4.33	4.33	P	0.18	2,235
338	25330	1	121	-0.50	127	-0.52	--	debitage	valid	4.89	4.89	P	0.53	2,850
336	25330	1	122	-0.49	128	-0.51	--	debitage	valid	4.63	4.63	P	0.37	2,555
710	25333	1	104	-0.64	108	-0.72	--	tool	valid	4.05	4.05	P	--	1,955
711	25333	--	104	-0.64	108	-0.72	--	tool	valid	4.29	4.29	P	0.15	2,194
714	25333	4	130	-0.43	129	-0.50	--	tool	valid	3.67	3.67	P	-0.23	1,605
737	25333	6	137	-0.37	120	-0.59	--	tool	valid	8.31	5.17	CdM	2.67	7,781
841	25333	8	139	-0.35	142	-0.36	--	point	valid	4.07	4.07	P	0.02	1,974
838	25480	13	364	1.52	299	1.34	--	point	valid	3.34	3.34	P	-0.44	1,330
839	25480	--	364	1.52	299	1.34	--	point	valid	3.35	3.35	P	-0.43	1,338
731	25480	10	368	1.55	305	1.40	--	tool	valid	3.92	3.92	P	-0.08	1,832
725	25480	31	369	1.56	281	1.14	--	tool	valid	4.21	4.21	P	0.10	2,113
836	25480	9	372	1.58	304	1.39	--	point	valid	5.89	5.39	OR	1.16	3,941
324	25480	3	382	1.67	300	1.35	--	debitage	valid	7.55	4.70	CdM	2.20	6,439
837	25480	6	386	1.70	311	1.47	--	point	valid	3.96	3.96	P	-0.05	1,869
834	25480	3	390	1.73	303	1.38	--	point	valid	4.30	4.30	P	0.16	2,204
833	25480	4	391	1.74	326	1.63	--	point	valid	3.74	3.74	P	-0.19	1,667
678	25480	40	391	1.74	334	1.71	--	tool	valid	3.11	3.11	P	-0.58	1,153
679	25480	--	391	1.74	334	1.71	--	tool	valid	3.06	3.06	P	-0.62	1,116
325	25480	1	391	1.74	335	1.72	--	debitage	valid	4.17	4.17	P	0.08	2,073
759	25480	38	392	1.75	331	1.68	--	tool	valid	3.35	3.35	P	-0.43	1,338
835	25480	23	392	1.75	336	1.74	--	point	valid	2.81	2.81	P	-0.77	941
750	25480	33	393	1.76	301	1.36	--	tool	valid	4.48	4.48	P	0.27	2,392
308	25480	1	393	1.76	335	1.72	--	debitage	valid	3.35	3.35	P	-0.43	1,338
319	25480	2	394	1.77	300	1.35	--	debitage	valid	7.52	4.68	CdM	2.18	6,369
320	25480	2	394	1.77	300	1.35	1	debitage	valid	6.56	4.08	CdM	1.57	4,852
321	25480	2	394	1.77	301	1.36	--	debitage	valid	5.11	3.18	CdM	0.67	2,944
773	25480	1	394	1.77	302	1.37	--	tool	valid	3.00	3.00	P	-0.65	1,073
774	25480	--	394	1.77	302	1.37	--	tool	valid	3.41	3.41	P	-0.40	1,386
774	25480	--	394	1.77	302	1.37	--	tool	valid	2.73	2.73	P	-0.82	888
322	25480	2	394	1.77	303	1.38	--	debitage	reused	7.70	4.79	CdM	2.29	6,687
322	25480	--	394	1.77	303	1.38	--	debitage	valid	5.24	3.26	CdM	0.75	3,100
681	25480	5	394	1.77	331	1.68	--	tool	valid	4.62	4.62	P	0.36	2,544
307	25480	1	394	1.77	333	1.70	--	debitage	reused	4.17	4.17	P	0.08	2,073
307	25480	--	394	1.77	333	1.70	--	debitage	valid	1.78	1.78	P	-1.42	378
784	25480	?	395	1.78	319	1.55	--	debitage	valid	3.84	3.84	P	-0.13	1,758

Table 7.1 (Continued).

CRMD Lab No.	Site (LA No.)	Artif. or Unit No.[1]	North Coor-dinate	Stand-ardized North Coor-dinate	East Coor-dinate	Stand-ardized East Coor-dinate	Level	Artifact Type	Occu-pation Dated?	POLEQUI (um)	Actual Measured[2] Rind If Not Polvadera	Mate-[3] rial Source	Stand-ardized Polvadera Rind Depth	Obsidian Hydration Date B.P. (8.[illegible] um[2] Pol. Rate)
323	25480	2	396	1.78	300	1.35	--	debitage	valid	3.67	3.67	P	-0.23	1,605
698	25480	32	396	1.78	320	1.56	--	tool	valid	2.86	2.86	P	-0.74	975
749	25480	17	397	1.79	331	1.68	--	tool	valid	3.64	3.64	P	-0.25	1,579
309	25480	1	408	1.88	333	1.70	--	debitage	valid	3.11	3.11	P	-0.58	1,153
310	25480	1	409	1.89	335	1.72	--	debitage	valid	2.26	2.26	P	-1.12	609
311	25480	1	411	1.91	335	1.72	--	debitage	valid	3.22	3.2[illegible]	P	-0.52	1,236
767	25480	22	412	1.92	335	1.72	--	tool	valid	2.83	2.83	P	-0.76	955
840	25480	21	413	1.92	334	1.71	--	point	valid	3.35	3.35	P	-0.43	1,338
312	25480	1	414	1.93	330	1.67	--	debitage	valid	4.61	4.61	P	0.35	2,533
313	25480	1	415	1.94	331	1.68	--	debitage	valid	5.13	5.13	P	0.68	3,137
314	25480	1	416	1.95	331	1.68	--	debitage	valid	4.74	4.74	P	0.44	2,678
707	25480	39	418	1.97	333	1.70	--	tool	valid	2.63	2.63	P	-0.89	824
708	25480	--	418	1.97	333	1.70	--	tool	reused	3.16	3.16	P	-0.55	1,190
315	25480	1	419	1.97	330	1.67	--	debitage	valid	3.48	3.48	P	-0.35	1,443
316	25480	1	419	1.97	330	1.67	1	debitage	reused	16.14	16.14	P	7.58	31,049
316	25480	--	419	1.97	330	1.67	1	debitage	valid	3.77	3.77	P	-0.17	1,694
317	25480	1	419	1.97	330	1.67	2	debitage	valid	3.10	3.10	P	-0.59	1,145
318	25480	1	419	1.97	330	1.67	3	debitage	valid	2.92	2.92	P	-0.70	1,016
832	25480	25	419	1.97	339	1.77	--	point	valid	?	?	?	--	--
771	25532	8	104	-0.64	132	-0.47	--	tool	valid	2.51	2.51	P	-0.96	751
826	25532	10	105	-0.63	129	-0.50	--	point	valid	3.26	3.26	P	-0.49	1,267
696	25532	16	109	-0.60	128	-0.51	--	tool	valid	5.17	3.22	CdM	0.71	3,016
329	25532	2	114	-0.56	125	-0.54	1	debitage	valid	3.50	3.50	P	-0.34	1,460
768	25532	5	114	-0.56	125	-0.54	--	tool	valid	3.00	3.00	P	-0.65	1,073
769	25532	--	114	-0.56	125	-0.54	--	tool	valid	2.7[illegible]	2.77	P	-0.80	915
332	25532	2	114	-0.56	125	-0.54	--	debitage	valid	3.02	3.02	P	-0.64	1,087
330	25532	2	117	-0.53	132	-0.47	--	debitage	valid	3.57	3.57	P	-0.30	1,519
722	25532	9	118	-0.53	129	-0.50	--	tool	valid	3.32	3.32	P	-0.45	1,314
723	25532	--	118	-0.53	129	-0.50	--	tool	valid	3.04	3.04	P	-0.63	1,102
331	25532	2	118	-0.53	130	-0.49	--	debitage	valid	2.80	2.80	P	-0.78	934
799	25532	2	119	-0.52	130	-0.49	--	debitage	valid	3.33	3.33	P	-0.45	1,322
802	25532	2	119	-0.52	133	-0.[illegible]5	--	debitage	valid	3.66	3.66	P	-0.24	1,597
729	25532	12	123	-0.48	101	-0.80	--	tool	valid	3.69	3.69	P	-0.22	1,623
688	25532	13	124	-0.48	109	-0.71	--	tool	reused	4.81	4.81	P	0.48	2,758
689	25532	--	124	-0.48	109	-0.71	--	tool	valid	2.99	2.99	P	-0.66	1,066
825	25532	2	126	-0.46	102	-0.79	--	point	valid	4.15	4.15	P	0.07	2,053
333	25532	1	[illegible]28	-0.44	107	-0.73	--	debitage	valid	2.31	2.31	P	-1.09	636
715	25532	14	128	-0.44	107	-0.73	--	tool	valid	0.94	0.94	P	-1.94	105
715	25532	--	128	-0.44	107	-0.73	--	tool	reused	3.12	3.12	P	-0.58	1,160
716	25532	--	128	-0.44	107	-0.73	--	tool	reused	1.87	1.87	P	-1.36	417
716	25532	--	128	-0.44	107	-0.73	--	tool	reused	2.72	2.72	P	-0.83	882

Table 7.1 (Continued).

CRMD Lab No.	Site (LA No.)	Artif. or Unit No.[1]	North Coor-dinate	Stand-ardized North Coor-dinate	East Coor-dinate	Stand-ardized East Coor-dinate	Level	Artifact Type	Occu-pation Dated?	POLEQUI (um)	Actual Measured[2] Rind If Not Polvadera	Mate-rial[3] Source	Stand-ardized Polvadera Rind Depth	Obsidian Hydration Date B.P. (8.39 um^2 Pol. Rate)
334	25532	1	128	-0.44	108	-0.72	--	debitage	valid	1.77	1.77	P	-1.42	373
701	25532	3	128	-0.44	108	-0.72	--	tool	reused	2.75	2.75	P	-0.81	901
702	25532	--	128	-0.44	108	-0.72	--	tool	valid	2.87	2.87	P	-0.73	982
733	25532	15	129	-0.43	113	-0.67	--	tool	valid	2.24	2.24	P	-1.13	598
828	27002	5	113	-0.57	102	-0.79	--	point	valid	7.04	4.38	CdM	1.88	5,593
691	27002	4	123	-0.48	116	-0.64	--	tool	valid	3.64	3.64	P	-0.25	1,579
738	27002	7	124	-0.48	119	-0.61	--	tool	valid	3.50	3.50	P	-0.34	1,460
744	27002	9	125	-0.47	111	-0.69	--	tool	valid	3.45	3.45	P	-0.37	1,419
788	27002	48	126	-0.46	111	-0.69	--	debitage	valid	3.62	3.62	P	-0.27	1,562
757	27002	1	128	-0.44	112	-0.68	--	tool	valid	4.13	4.13	P	0.05	2,033
758	27002	--	128	-0.44	112	-0.68	--	tool	valid	3.79	3.79	P	-0.16	1,712
673	27002	6	129	-0.43	112	-0.68	--	tool	valid	3.56	3.56	P	-0.30	1,511
827	27002	2	129	-0.43	116	-0.64	--	point	valid	4.43	4.43	P	0.24	2,339
815	27018	12	99	-0.68	124	-0.55	--	point	valid	6.19	3.85	CdM	1.34	4,319
816	27018	--	99	-0.68	124	-0.55	--	point	reused	6.88	4.28	CdM	1.78	5,334
736	27018	10	100	-0.67	122	-0.57	--	tool	valid	3.76	3.76	P	-0.18	1,685
326	27018	1	101	-0.67	100	-0.81	--	debitage	valid	3.43	3.43	P	-0.38	1,402
327	27018	1	101	-0.67	104	-0.77	--	debitage	valid	3.61	3.61	P	-0.27	1,553
684	27018	31	101	-0.67	151	-0.26	--	tool	reused	5.49	5.49	P	0.91	3,592
685	27018	--	101	-0.67	151	-0.26	--	tool	valid	4.88	4.88	P	0.52	2,838
760	27018	48	102	-0.66	100	-0.81	--	tool	valid	2.91	2.91	P	-0.71	1,009
794	27018	1	102	-0.66	104	-0.77	--	debitage	valid	4.76	4.76	P	0.45	2,701
761	27018	49	102	-0.66	110	-0.70	--	tool	valid	3.25	3.25	P	-0.50	1,259
792	27018	1	103	-0.65	106	-0.75	--	debitage	valid	3.78	3.78	P	-0.16	1,703
751	27018	47	103	-0.65	106	-0.75	--	tool	valid	3.20	3.20	P	-0.53	1,221
752	27018	--	103	-0.65	106	-0.75	--	tool	valid	3.11	3.11	P	-0.58	1,153
779	27018	1	103	-0.65	132	-0.47	--	debitage	valid	3.66	3.66	P	-0.24	1,597
782	27018	1	104	-0.64	101	-0.80	--	debitage	valid	?	?	?	--	--
781	27018	1	104	-0.64	102	-0.79	--	debitage	valid	3.51	3.51	P	-0.33	1,468
793	27018	1	104	-0.64	105	-0.76	--	debitage	valid	3.23	3.23	P	-0.51	1,243
777	27018	1	104	-0.64	128	-0.51	--	debitage	reused	6.65	6.65	P	1.63	5,271
777	27018	--	104	-0.64	128	-0.51	--	debitage	valid	4.60	4.60	P	0.35	2,522
817	27018	28	105	-0.63	126	-0.53	--	point	valid	3.65	3.65	P	-0.25	1,588
818	27018	--	105	-0.63	126	-0.53	--	point	valid	3.44	3.44	P	-0.38	1,410
778	27018	1	105	-0.63	128	-0.51	--	debitage	valid	3.35	3.35	P	-0.43	1,338
791	27018	1	106	-0.62	103	-0.78	--	debitage	valid	3.37	3.37	P	-0.42	1,354
328	27018	1	106	-0.62	105	-0.76	--	debitage	valid	?	?	?	--	--
790	27018	1	106	-0.62	106	-0.75	--	debitage	valid	3.59	3.59	P	-0.28	1,536
821	27018	6	106	-0.62	117	-0.63	--	point	valid	3.09	3.09	P	-0.60	1,138
822	27018	--	106	-0.62	117	-0.63	--	point	valid	2.68	2.68	P	-0.85	856
819	27018	26	106	-0.62	124	-0.55	--	point	valid	5.56	5.56	P	0.95	3,685

Table 7.1 (Continued).

CRMD Lab No.	Site (LA No.)	Artif. or Unit No.[1]	North Coordinate	Standardized North Coordinate	East Coordinate	Standardized East Coordinate	Level	Artifact Type	Occupation Dated?	POLEQUI (um)	Actual Measured[2] Rind If Not Polvadera	Material[3] Source	Standardized Polvadera Rind Depth	Obsidian Hydration Date B.P. ($8.39\ um^2$ Pol. Rate)
813	27018	3	111	-0.58	170	-0.06	--	point	valid	3.26	3.26	P	-0.49	1,267
814	27018	--	111	-0.58	170	-0.06	--	point	valid	3.26	3.26	P	-0.49	1,267
823	27018	2	111	-0.58	170	-0.06	--	point	valid	3.36	3.36	P	-0.43	1,346
824	27018	--	[illegible]	-0.58	170	-0.06	--	point	reused	4.62	4.62	[illegible]	0.36	2,544
745	27018	20	[illegible]	-0.30	7	-1.81	--	tool	reused	4.55	4.55	P	0.32	2,468
746	27018	--	145	-0.30	7	-1.81	--	tool	valid	3.79	3.79	P	-0.16	1,712
746	27018	--	145	-0.30	7	-1.81	--	tool	reused	4.39	4.39	P	0.22	2,297
848	27020	12	82	-0.82	134	-0.44	--	point	valid	5.07	5.07	P	0.64	3,064
849	27020	--	82	-0.82	134	-0.44	--	point	valid	?	?	?	--	--
847	27020	14	82	-0.82	151	-0.26	--	point	valid	3.46	3.46	P	-0.37	1,427
843	27020	11	106	-0.62	103	-0.78	--	point	valid	3.38	3.38	P	-0.42	1,362
844	27020	--	106	-0.62	103	-0.78	--	point	valid	3.12	3.12	P	-0.58	1,160
335	27020	1	108	-0.61	118	-0.62	--	debitage	valid	4.07	4.07	P	0.02	1,974
690	27020	9	113	-0.57	134	-0.44	--	tool	valid	4.03	4.03	P	-0.01	1,936
846	27020	13	137	-0.37	172	-0.03	--	point	valid	2.71	2.71	P	-0.84	875
756	27041	7	118	-0.53	117	-0.63	--	tool	valid	3.89	3.89	P	-0.10	1,804
683	27041	12	124	-0.48	108	-0.72	--	tool	valid	4.51	4.51	P	0.29	2,424
800	27041	1	124	-0.48	112	-0.68	--	debitage	valid	4.43	4.43	P	0.24	2,339
353	27041	1	124	-0.48	114	-0.66	1	debitage	valid	2.36	2.36	P	-1.05	664
356	27041	1	124	-0.48	114	-0.66	1	debitage	valid	3.54	3.54	P	-0.32	1,494
352	27041	1	124	-0.48	114	-0.66	2	debitage	valid	4.63	4.63	P	0.37	2,555
354	27041	1	124	-0.48	114	-0.66	2	debitage	valid	2.72	2.72	P	-0.83	882
355	27041	1	124	-0.48	114	-0.66	2	debitage	valid	2.32	2.32	P	-1.08	642
350	27041	1	125	-0.47	108	-0.72	--	debitage	valid	3.31	3.31	P	-0.46	1,306
703	27041	20	125	-0.47	108	-0.72	--	tool	reused	4.25	4.25	P	0.13	2,153
704	27041	--	125	-0.47	108	-0.72	--	tool	reused	3.70	3.70	P	-0.22	1,632
704	27041	--	125	-0.47	108	-0.72	--	tool	valid	3.03	3.03	P	-0.63	1,094
728	27041	21	125	-0.47	109	-0.71	--	tool	valid	4.46	4.46	P	0.26	2,371
798	27041	1	125	-0.47	110	-0.70	--	debitage	valid	3.72	3.72	P	-0.20	1,649
739	27041	13	125	-0.47	111	-0.69	--	tool	valid	3.95	3.95	P	-0.06	1,860
740	27041	--	125	-0.47	111	-0.69	--	tool	valid	3.60	3.60	P	-0.28	1,545
803	27041	1	125	-0.47	112	-0.68	--	debitage	valid	5.13	5.13	P	0.68	3,137
351	27041	1	125	-0.47	114	-0.66	--	debitage	valid	4.11	4.11	P	0.04	2,013
349	27041	1	126	-0.46	107	-0.73	--	debitage	valid	3.29	3.29	P	-0.47	1,290
797	27041	1	128	-0.44	108	-0.72	--	debitage	valid	3.09	3.09	P	-0.60	1,138
717	27041	4	128	-0.44	112	-0.68	--	tool	valid	3.06	3.06	P	-0.62	1,116
845	27041	1	129	-0.43	101	-0.80	--	point	valid	3.84	3.84	P	-0.13	1,758
348	27041	1	129	-0.43	109	-0.71	--	debitage	valid	3.03	3.03	P	-0.63	1,094
795	27041	1	129	-0.43	110	-0.70	--	debitage	valid	2.62	2.62	P	-0.89	818
753	27041	19	129	-0.43	110	-0.70	--	tool	valid	3.38	3.38	P	-0.42	1,362
829	27041	2	129	-0.43	114	-0.66	--	point	valid	3.35	3.35	P	-0.43	1,338

Table 7.1 (Continued).

CRMD Lab No.	Site (LA No.)	Artif. or Unit No.[1]	North Coor- dinate	Stand- ardized North Coor- dinate	East Coor- dinate	Stand- ardized East Coor- dinate	Level	Artifact Type	Occu- pation Dated?	POLEQUI (um)	Actual Measured[2] Rind If Not Polvadera	Mate-[3] rial Source	Stand- ardized Polvadera Rind Depth	Obsidian Hydration Date B.P. (8.39 um[2] Pol. Rate)
830	27041	--	129	-0.43	114	-0.66	--	point	valid	3.29	3.29	P	-0.47	1,290
295	27042	2	240	0.49	271	1.03	--	debitage	valid	3.56	3.56	P	-0.30	1,511
290	27042	2	240	0.49	271	1.03	1	debitage	valid	3.08	3.08	P	-0.60	1,131
291	27042	2	240	0.49	271	1.03	1	debitage	valid	3.24	3.24	P	-0.50	1,251
292	27042	2	240	0.49	271	1.03	1	debitage	valid	3.60	3.60	P	-0.28	1,545
293	27042	2	240	0.49	271	1.03	1	debitage	valid	3.63	3.63	P	-0.26	1,571
294	27042	2	240	0.49	271	1.03	1	debitage	valid	3.55	3.55	P	-0.31	1,502
288	27042	2	240	0.49	271	1.03	2	debitage	valid	3.52	3.52	P	-0.33	1,477
289	27042	2	240	0.49	271	1.03	2	debitage	valid	2.43	2.43	P	-1.01	704
785	27042	?	242	0.50	272	1.05	--	debitage	valid	4.41	4.41	P	0.23	2,318
296	27042	2	242	0.50	273	1.06	--	debitage	valid	4.25	4.25	P	0.13	2,153
297	27042	2	243	0.51	272	1.05	--	debitage	valid	3.54	3.54	P	-0.32	1,494
298	27042	2	243	0.51	273	1.06	--	debitage	valid	2.45	2.45	P	-1.00	715
299	27042	2	244	0.52	273	1.06	--	debitage	reused	8.27	8.27	P	2.65	8,152
299	27042	--	244	0.52	273	1.06	--	debitage	valid	4.68	4.68	P	0.40	2,611
300	27042	3	270	0.74	301	1.36	--	debitage	valid	3.61	3.61	P	-0.27	1,553
301	27042	3	272	0.75	300	1.35	--	debitage	valid	3.62	3.62	P	-0.27	1,562
302	27042	3	272	0.75	300	1.35	--	debitage	valid	3.56	3.56	P	-0.30	1,511
875	27042	10	289	0.89	285	1.19	--	point	reused	6.16	6.16	P	1.33	4,523
876	27042	--	289	0.89	285	1.19	--	point	valid	3.30	3.30	P	-0.47	1,298
692	27042	4	297	0.96	301	1.36	--	tool	valid	4.50	4.50	P	0.29	2,414
693	27042	--	297	0.96	301	1.36	--	tool	valid	4.51	4.51	P	0.29	2,424
682	27042	8	301	0.99	299	1.34	--	tool	valid	3.96	3.96	P	-0.05	1,869
770	27042	7	305	1.03	299	1.34	--	tool	valid	4.44	4.44	P	0.25	2,350
873	27042	2	305	1.03	338	1.76	--	point	valid	4.25	4.25	P	0.13	2,153
726	27042	9	308	1.05	299	1.34	--	tool	valid	3.69	3.69	P	-0.22	1,623
727	27042	--	308	1.05	299	1.34	--	tool	reused	4.87	4.87	P	0.52	2,827
303	27042	4	309	1.06	286	1.20	--	debitage	valid	4.26	4.26	p	0.14	2,163
304	27042	4	309	1.06	286	1.20	--	debitage	valid	4.76	4.76	P	0.45	2,701
748	27042	12	309	1.06	286	1.20	--	tool	valid	4.33	4.33	P	0.18	2,235
699	27042	13	309	1.06	290	1.24	--	tool	valid	4.06	4.06	P	0.01	1,965
305	27042	4	309	1.06	293	1.27	--	debitage	valid	4.05	4.05	P	--	1,955
306	27042	4	310	1.07	287	1.21	--	debitage	valid	4.44	4.44	P	0.25	2,350
871	27042	6	363	1.51	300	1.35	--	point	valid	4.39	4.39	P	0.22	2,297
872	27042	--	363	1.51	300	1.35	--	point	valid	4.42	4.42	P	0.24	2,329
343	51698	3	91	-0.75	93	-0.89	--	debitage	valid	3.56	3.56	P	-0.30	1,511
850	51698	1	100	-0.67	100	-0.81	--	point	reused	11.59	7.21	CdM	4.72	15,139
850	51698	--	100	-0.67	100	-0.81	--	point	valid	6.89	4.24	CdM	1.79	5,239
342	51698	3	102	-0.66	91	-0.91	--	debitage	valid	5.93	3.69	CdM	1.18	3,968
853	51698	5	104	-0.64	90	-0.92	2	point	valid	3.71	2.31	CdM	-0.21	4,010
341	51698	3	104	-0.64	90	-0.92	3	debitage	valid	3.11	3.11	P	-0.58	1,153

Table 7.1 (Continued).

CRMD Lab No.	Site (LA No.)	Artif. or Unit No.[1]	North Coor-dinate	Stand-ardized North Coor-dinate	East Coor-dinate	Stand-ardized East Coor-dinate	Level	Artifact Type	Occu-pation Dated?	POLEQUI (um)	Actual Measured[2] Rind If Not Polvadera	Mate-[3] rial Source	Stand-ardized Polvadera Rind Depth	Obsidian Hydration Date B.P. (8.39 um[2] Pol. Rate)
780	51698	?	104	-0.64	90	-0.92	3	debitage	valid	7.26	4.52	CdM	2.02	5,941
772	51698	3	117	-0.53	116	-0.64	--	tool	valid	2.46	2.46	P	-0.99	721
851	51698	7	119	-0.52	135	-0.43	--	point	valid	2.15	2.15	P	-1.19	551
852	51698	--	119	-0.52	135	-0.43	--	point	valid	2.48	2.48	P	-0.98	733
674	51700	13	295	0.94	204	0.31	--	tool	valid	3.62	3.62	P	-[illegible].27	1,562
732	51700	7	296	0.95	291	1.25	--	tool	valid	6.54	4.07	CdM	1.56	4,656
344	51700	1	316	0.12	293	1.27	1	debitage	valid	3.57	3.57	P	-0.30	1,519
783	51700	?	316	1.12	293	1.27	2	debitage	valid	3.29	3.29	P	-0.47	1,290
856	51700	9	320	1.15	290	1.24	--	point	valid	4.47	4.47	P	0.27	2,382
857	51700	--	320	1.15	290	1.24	--	point	valid	4.61	4.16	P	0.35	2,533
854	51700	10	323	1.18	301	1.36	--	point	valid	3.75	3.43	OR	-0.18	1,597
855	51700	--	323	1.18	301	1.36	--	point	valid	3.42	3.13	OR	-0.39	1,330
859	51700	2	342	1.34	303	1.38	--	point	valid	?	?	?	--	--
860	51700	--	342	1.34	303	1.38	--	point	valid	?	?	?	--	--
680	51700	4	343	1.34	301	1.36	--	tool	valid	3.47	3.47	P	-0.36	1,435
680	51700	--	343	1.34	304	1.39	--	tool	reused	4.01	4.01	P	-0.02	1,917
676	51700	5	343	1.34	306	1.41	--	tool	valid	4.42	4.42	P	0.24	2,329
713	51700	11	344	1.35	301	1.36	--	tool	valid	2.13	2.13	P	-1.20	541
713	51700	--	344	1.35	301	1.36	--	tool	reused	3.56	3.56	P	-0.30	1,511
787	51700	2	344	1.35	305	1.40	--	debitage	valid	3.22	3.22	P	-0.52	1,236
345	51700	2	344	1.35	309	1.44	--	debitage	valid	2.97	2.97	P	-0.67	1,051
346	51700	2	345	1.36	302	1.37	--	debitage	valid	3.36	3.36	P	-0.43	1,346
786	51700	2	346	1.37	304	1.39	--	debitage	valid	3.60	3.60	P	-0.28	1,545
858	51700	6	347	1.38	307	1.42	--	point	valid	4.40	4.40	P	0.22	2,308
347	51700	2	348	1.38	309	1.44	--	debitage	valid	3.37	3.37	P	-0.42	1,354
675	51702	4	77	-0.87	113	-0.67	--	tool	valid	3.00	3.00	P	-0.65	1,073
675	51702	--	77	-0.87	113	-0.67	--	tool	valid	?	?	?	--	--
697	51703	14	100	-0.67	85	-0.97	--	tool	valid	2.87	2.87	P	-0.73	982
831	51703	12	104	-0.64	90	-0.92	--	point	valid	12.87	12.87	P	5.53	19,742

1 Artifact number listed for tools, unit number for debitage. A '--' in this column indicates subsequent dated cuts on the first-listed item.

2 Measured rinds for OR and CdM obsidians from Stevenson (Appendix B). Polvadera equivalent is the actual measured rind for Polvadera obsidian only.

3 Material sources, from Hughes (Appendix A):

P Polvadera Peak 3530
OR Obsidian Ridge 3520/3525
CdM Cerro del Medio

Polvadera equivalent rind widths (as in the cluster analysis in this chapter) are present but slight.

7.4 STATISTICAL ANALYSIS AND OBSIDIAN

The recognition of spatiotemporal patterns in artifact distributions, especially in deflated sites, presupposes that one can successfully segregate spatial clusters pertaining to a single event or to superimposed or ongoing similar events. Isolating single-component assemblages is a longstanding problem in archaeology; previous approaches to its solution have relied on material homogeneity analysis or reduction trajectory homogeneity analysis as in Chapter 6. Alternative approaches, which might be termed reductive, have employed methods, often originally developed in bone taphonomic studies (cf. Behrensmeyer and Hill 1980, Kroll and Isaac 1984), to eliminate patterns ascribable to natural processes from cluster candidacy. An exciting and novel approach to this was developed by Kuhn and the author for the Abiquiu project (see Chapter 10).

Generally, the problem of recognition of spatial patterns having inferable behavioral meaning in the context of typical sites has greatly interested the archaeological community for some time. The results of initial studies have generally been bold, provocative, and disheartening. Wandsnider (1986) presented experimental evidence that sites in sand dunes with apparent depositional integrity experienced massive mixing due to natural soil processes; Larralde (1985) suggested that apparent intact sites in the Seedskadee area of Wyoming were in many cases palimpsests composed of many occupations, each of which left only a few items behind, or which only recycled older artifacts. She noted that the research problems implied by any current approach to the task of associating dated loci with undated items are formidable:

> The difficulty of the task does not stem from the fact that the site's assemblage as we may currently know it is from a disturbed, distorted surface context, or from the fact that it is situated in a dynamic natural setting. Sealed "occupations" are just as likely to consist of mixtures of multiple use episodes of a place (Larralde 1985:10).

In a similar but much older context, the same problems were found to apply:

> Our analytic work thus far strongly suggests that, where the East African Plio-Pleistocene open-air sites formed on loose sandy or silty substrates, post-depositional processes could have readily dispersed an archaeological zone through a thickness of at least 10 to 15 cm of sediment. Archaeological zones spread through more than 15 cm of sediment pose problems for the spatial analyst on how to demarcate a useful analytic entity. For the time being, exploration of the following approaches seems best to us: (1) allowing the network of conjoining stone and bone pieces to define segments of the vertically dispersed zone as horizontal units for spatial analysis, and (2) defining

> arbitrary vertical subdivisions and searching for coherent spatial patterns within them on an iterative, trial and error basis (Kroll and Isaac 1984:12).

By contrast, when the items of interest (stone tools) are directly dateable, the problem may be partially resolved. Items of different hydration ages which occur together are probably not behaviorally related, but separated items of equal age may be so related. In this approach, it becomes necessary to determine, in some relatively objective fashion, whether meaningful spatial associations exist within a site between objects of equivalent age.

Whallon (1984) has reviewed various methods of spatial-typological pattern recognition; he concludes that various cluster analysis approaches are more appropriate than the variance analysis, factor and componential analysis, or density analysis methods suggested earlier by himself (Whallon 1973, 1974).

K-means clustering analysis (Hartigan 1975) is a nonhierarchical method, unlike tree-clustering methods (Sneath and Sokal 1973, Hartigan 1975) which assume that clusters exist in the data only as properly nested subsets. K-means analysis, by contrast, produces a result for n clusters which is independent of its results for n-1 or n+1 clusters; it simply "splits a set of objects into a selected number of groups by maximizing between-cluster relative to within-cluster variation. In rough terms, it is like doing a one-way analysis of variance where the groups are unknown and the largest *F*-value is sought by reassigning members to each group" (Wilkinson 1986:Chapter 1). This procedure is advantageous in cases where clustering is being employed in a heuristic, rather than an analytic, mode since a best clustering into three groups often would be expected to produce clusters which were neither proper subsets of the best two-cluster solution, nor proper supersets of the best four-cluster solution. The resulting unconstrained search potential, compared to joining or hierarchical methods, is highly desirable under Whallon's criterion of unconstraint:

> The challenge, then, is to develop an approach to spatial analysis that is in fact free from constraint in all these respects. This approach must define spatial scatters or clusters over an area in such a way that size, shape, density, composition, and patterns of association or covariation are no longer constraining factors, but are variables in terms of which the spatial scatters or clusters may be described. This description would not be conditioned by methods of analysis, therefore, but rather would be informative of structure or patterning inherent in the data. This structure or patterning, in turn, may be significantly informative of the processes or activities by which the observed spatial distributions were formed (Whallon 1984:244).

The coordinates and Polvadera equivalents from Table 7.1 were standardized over the entire data set using the STANDARDIZE algorithm from SYSTAT Version 3 (Wilkinson 1986). K-means analysis was carried out on this

standardized set using the CLUSTER package from SYSTAT. All work was performed on the author's IBM-XT compatible computer.

Standardization over the entire data set, rather than by site, was elected in order to mitigate the effects of scale magnitude differences between variables discussed by Hartigan (1975). This strategy ensured that, in cluster variance calculations, the rind thickness variable (range 0-14 microns) was not overshadowed by the spatial variables (range 0-450 m).

Given the nature of the artifact collection strategies employed at Abiquiu, it was expected that several orders of cluster meaningfulness would arise from K-means analysis of the obsidian data. First, spurious clusters were generated by the decision to collect in several separated blocks of m^2 units; each block represented by analyzed obsidian then gave rise to a spatial cluster. Within a block, MAI's deliberate effort to sample obsidian both from apparent concentrations and from the overall unit tended to ensure that actual spatial clusters might be detected, in that sampling intensity was fairly highly correlated with overall obsidian frequency for debitage. This non-rigorous but approximately random sampling was in some cases overshadowed by the total collection and analysis strategy contractually mandated for formal obsidian tools. The overall result was that spatial clusters were not always meaningful and that the different dynamics underlying discard of debitage versus tools may, in some cases, have obscured patterns or produced spurious patterns.

Similarly, MAI's inability to sample obsidian *pre-hoc* randomly with regard to time ensured that some sample sets would inevitably poorly reflect the actual range of obsidian rind thicknesses; i.e., some clusters would be detected because obsidian from the early and late ends of a real distribution was analyzed, but not obsidian having modal hydration development.

In general, cluster analysis performed on a typical site revealed good clustering for several different ranges of cluster numbers defined. Separation of the meaningful clusters from the spurious artifacts of field or lab selection was somewhat subjective; with a research design that assumes scatter sites are strongly multicomponent and with much more intensive dating effort (i.e., more cuts on more rocks), this subjectivity need not be the case in future studies.

A useful approach to detecting good clustering can be based on inspection of changes in the *F*-ratio statistic for each variable, but especially for POLEQUI, the standardized Polvadera equivalent rind thickness. In general, if the *F*-ratio increases substantially with a small increase in the number of clusters isolated, this indication of a substantial decline in sum-of-squares deviations within clusters summed over all clusters can be taken to imply that a loose cluster has been split into tight clusters, improving the solution.

Caution must be exercised, however, because as the number of clusters extracted tends toward the number of points in the data set (i.e., all clusters contain one item), the *F*-ratio tends exponentially to infinity. A measure of subjective judgment must be used in assessing the quality of a

solution; higher F-ratios may simply indicate total fractionation of the data set.

7.5 SITE-BY-SITE DISCUSSION OF SPATIOTEMPORAL CLUSTERS

7.5.1 Site LA 25328

From this site, 72 cuts were reported by Stevenson (Appendix B) and sourced by Hughes (Appendix A). K-means analysis suggested the presence of five spatial clusters, closely reflecting the collection units (Figure 7.1).

Spatial cluster 1 contained four cuts on a flake of pre-PaleoIndian age (Figure 8.3E) recycled during the Middle Archaic into a projectile point, probably of the Lamy (14) or Llaves (12) types (Thoms 1977).

Spatial cluster 2 consisted of a surface tool and the subsurface obsidian found in the lithic cache reported by Kuhn (Chapter 10). All nonrecycled dates indicate a Late Archaic date for the cache contents and a Basketmaker date for the surface tool. Recycled dates indicate reuse of materials dating from much earlier times (6,200 B.P.); these tools were perhaps imported to the locus.

Spatial cluster 3, equivalent to test Unit 3, exhibited Archaic occupations at 3,000 B.P. (cluster 27) and 2,500 B.P. (cluster 4), Basketmaker occupation at A.D. 0-400 (clusters 8 and 33); and Puebloan period use from A.D. 750 to 1250 (clusters 15 and 31).

Spatial cluster 4, equivalent to collection Unit 5, yielded an early cluster at 4,800 B.P. (cluster 22), a middle to late Archaic cluster at 3,000 B.P. (cluster 16); and intense occupation from 2,000 B.P. to A.D. 850 (clusters 1, 18, and 34). A single item (cluster 9) might pertain to Puebloan use.

Spatial cluster 5 (collection Unit 1) produced a flake from a recycled Middle Archaic tool or core, detached during Basketmaker time (cluster 7), during which time (clusters 26 and 6) more debitage was produced during one or two episodes.

Spatial cluster 6 (collection Unit 4) produced three temporal clusters: Early Late Archaic at 3,000 B.P. (cluster 30), Late Archaic at 75 B.C. (cluster 6); and Basketmaker at A.D. 600 (cluster 14).

Spatial cluster 7 (collection Unit 2) indicated only one occupation, from a tool and a flake, dating to A.D. 100.

Additional clusters were a nongridded item (K-means cluster 10), an outlier point at 126N/100E (cluster 17), three pieces of debitage (cluster 26), and a tool at 107N/93E. These items were either too temporally or spatially distant to be included with other clusters.

In general, if the hydration dates and rates are accepted as accurate, LA 25328 exhibited Middle and Late Archaic and Basketmaker occupation with little

Figure 7.1 Obsidian K-Means Analysis For Site LA 25328, Abiqui Archaeological Study, 1989.

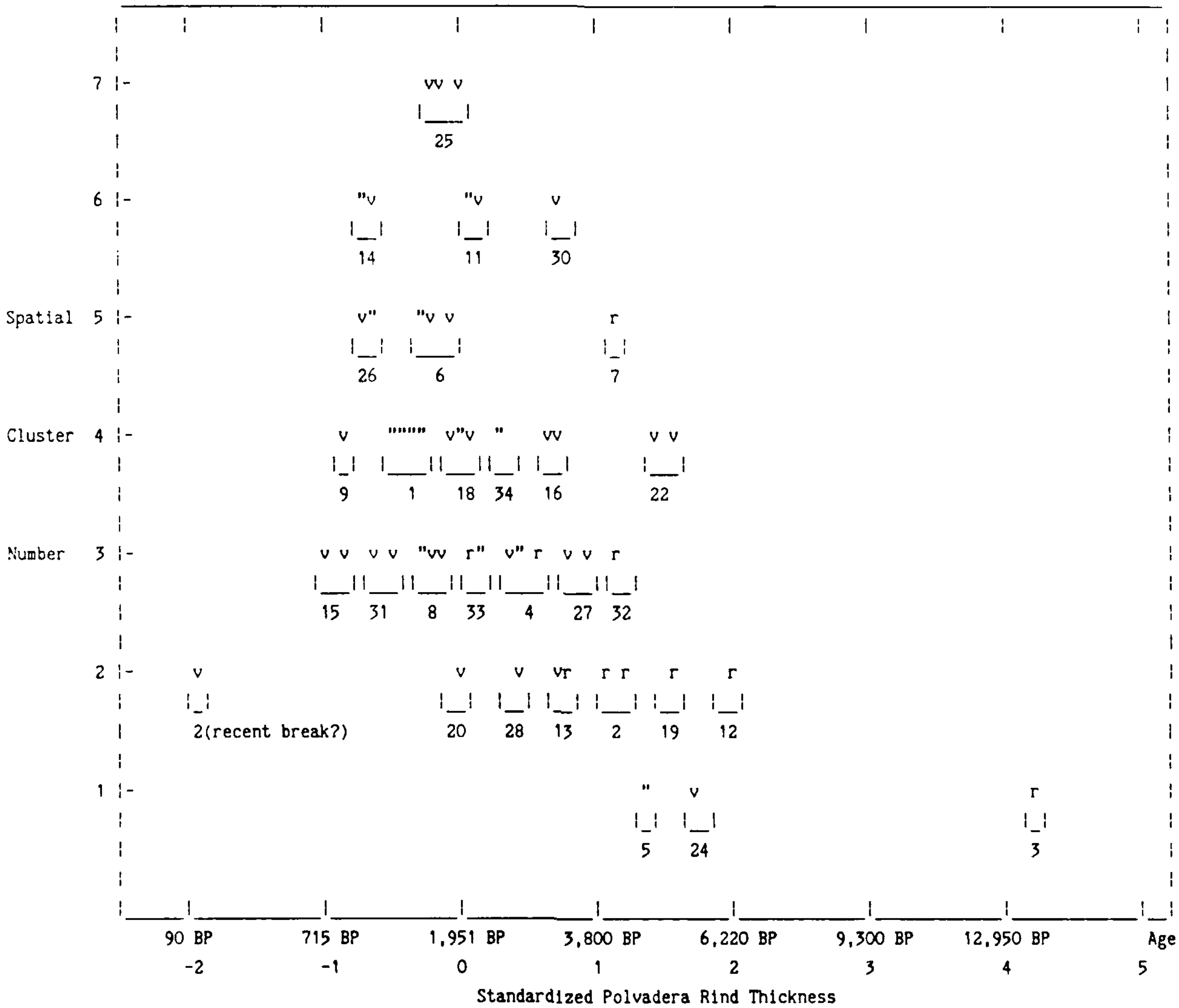


Figure 7.1 (Continued).

K-Means Cluster Numbers	Spatial Cluster	Collection Unit	Range North	Range East	Notes
3,5,24	1	Other	69	89	Single point with 4 cuts.
2,12,19,23, 13,20,28	2	6	53-54	125-129	2-3 occupations, much recycling. 9 cuts (7 tool, 1 debitage, 1 misc.).
4,8,15,27, 31,32,33	3	3	52-60	144-154	Possibly 2-3 occupations, 19 cuts (12 tools, 6 debitage, 1 point).
1,9,16,18, 22, 34	4	5	80-97	99-113	Possibly 4 occupations, 21 cuts (1 tool, 16 debitage, 4 point).
6,7,21	5	1	148-153	55-61	2 occupations and a single recycled item, 6 cuts (2 tool, 4 debitage).
11,14,30	6	4	42-46	83-96	2-3 occupations, 7 cuts (5 debitage, 2 point).
25	7	2	105	125	1 occupation, 3 cuts (2 tools and 1 debitage).

Key

v = valid date

r = recycled earlier date

|_| = K-means cluster number on 34 clusters
#

" = multiple dates

earlier or later use. A total of perhaps seven or eight occupational periods is reflected, most occurring over three collection units and none limited to a single unit. Only collection Unit 2 (spatial cluster 7) exhibited a single occupation scatter, which may be a sampling error since only two items with a total of three rind values were studied at this locus.

Obsidian projectile points from LA 25328 included the Lamy/Llaves Middle Archaic base already described; two similar bases of Cochiti straight-based type 15 (Thoms 1977) but probably variants of the Lamy/Llaves architecture and dating to 2,500-2,800 B.C. (Figure 8.3G) and 1,000-900 B.C. (Figure 8.3F), respectively; a possibly similar point, reworked but with only the haft dated to 3,300 B.C. (Figure 8.3I); a smaller point of the Narrow Notch-Convex Base type 27 (Thoms 1977) dating to 950 B.C. (Figure 8.3J); a larger but morphologically similar to type 27 piece dating to A.D. 800 (Figure 8.3H); and a large, thin, probably corner-notched fragment dating to 500 B.C. (Figure 8.3K). These dates tend to be consistently rather earlier than the bulk of associated debitage and tools, suggesting systematic collection of earlier points by later occupants (see Chapter 8 for further discussion).

7.5.2 Site LA 25330

From this site, 15 cuts were reported. K-means analysis suggested the presence of two spatial clusters within a single collection unit (Figure 7.2), as well as a single tool evidencing reuse.

Spatial cluster 1 contained a tool and five debitage cuts; it appeared to represent one or two occupations pertaining to the Late Archaic.

Spatial cluster 2 contained four cuts exclusively on tools; these represented a PaleoIndian item (K-means cluster 2) at 10,000 B.P.; a Middle Archaic tool at 3,600 B.P.; and a pair of Pueblo III tools at A.D. 1260.

Spatial cluster 3 consisted of a single Late Archaic/Basketmaker tool, dating at A.D. 100 and recycled A.D. 390.

Ignoring single dates, two Late Archaic occupations, one or two Basketmaker occupations, and a Pueblo III occupation are represented in this sample.

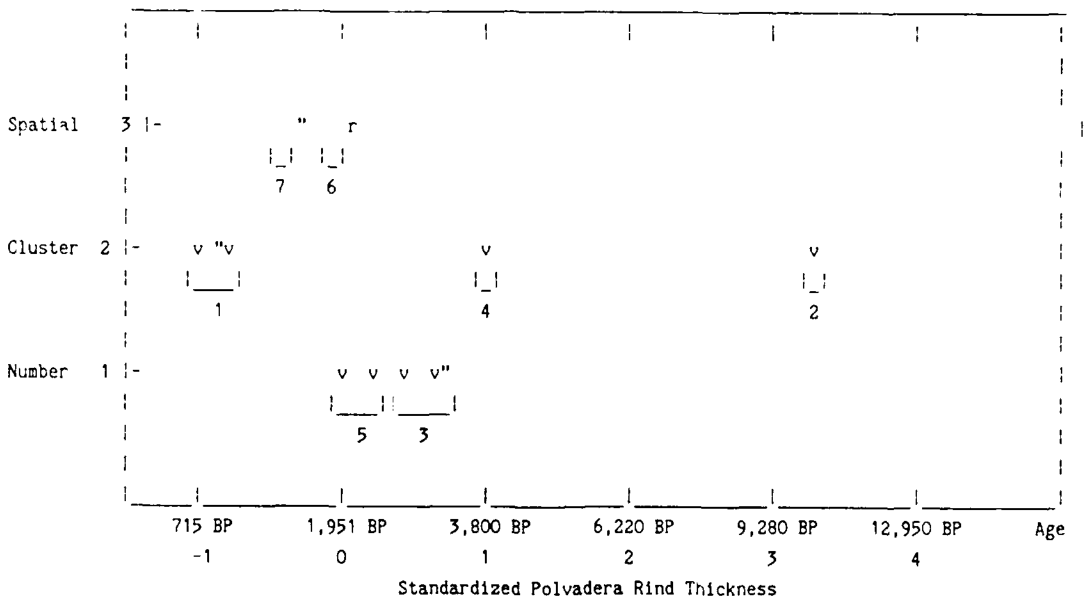
7.5.3 Site LA 25333

The five rinds reported from this site are insufficient to support analysis; all but one pertain to the period around A.D. 1, including an En Medio point (Figure 8.1B). The odd date, from a biface fragment, dated to 6,200 B.C. (see Chapter 8 for further discussion).

7.5.4 Site LA 25480

From this site, 47 rinds were reported by Stevenson (Appendix B). K-means analysis suggested the presence of four spatial clusters and one isolated piece (Figure 7.3), following closely the collection units.

Figure 7.2 Obsidian K-Means Analysis for Site LA 25330, Abiquiu Archaeological Study, 1989.



K-Means Cluster Numbers	Spatial Cluster	Collection Unit	Range North	Range East	Notes
3,5	1	1	108-122	115-129	1 tool, 5 debitage cuts.
1,2,4	2	1	103-110	99-107	6 tool cuts.
6,7	3	1	100	118	3 cuts (1 tool).

Key

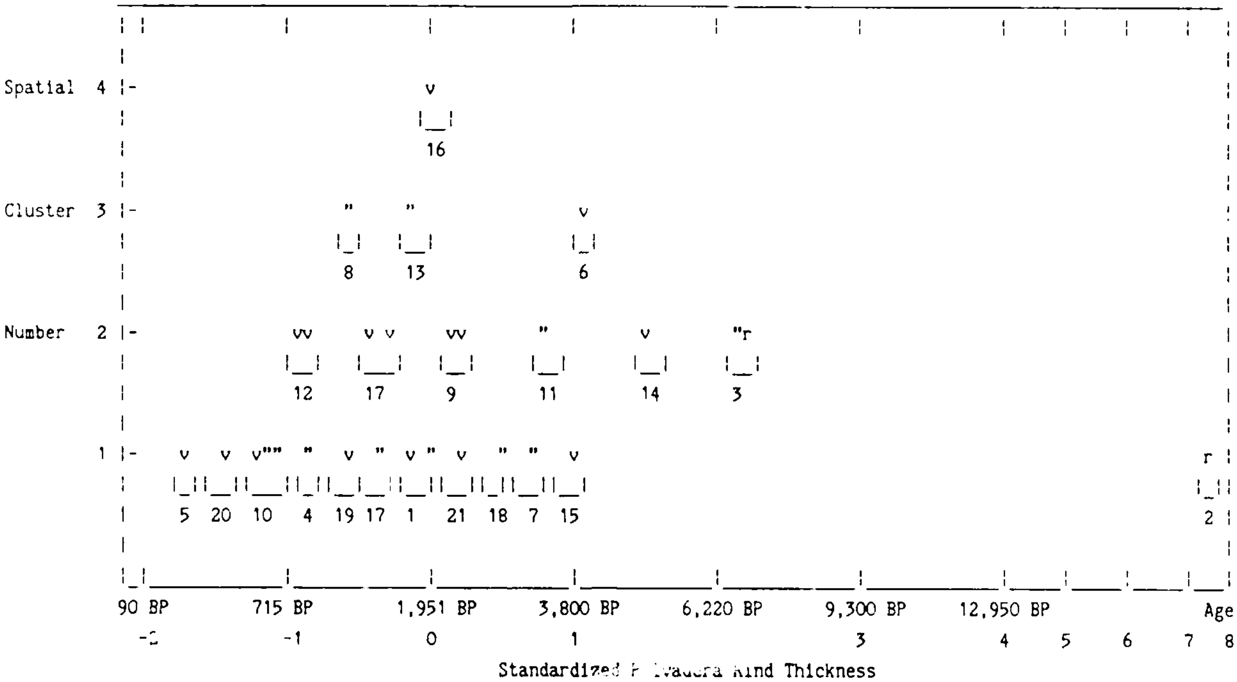
v = valid date

r = recycled earlier date

|_| = K-means cluster number on 34 clusters
#

" = multiple dates

Figure 7.3 Obsidian K-Means Analysis For Site LA 25480, Abiquiu Archaeological Study, 1989.



K-Means Cluster Numbers	Spatial Cluster	Range North	Range East	Notes
1,2,4,5,7,10,15,18,19,20,21	1	391-419	319-339	29 cuts (9 tool, 16 debitage, 4 point).
3,9,11,12,14,17	2	382-397	300-303	12 cuts (4 tool, 7 debitage, 1 point).
6,8,13	3	368-386	299-311	5 cuts (1 tool, 4 point).
16	4	369	281	1 tool cut.

Key

v = valid date

r = recycled earlier date

|_| = K-means cluster number
#

" = multiple dates

Spatial cluster 1 contained a Middle Late Pleistocene (30,650 B.P.) obsidian piece (CRMD 86-316) reworked during Basketmaker times and an essentially continuous scatter dating from 3,000 B.P. to A.D. 1600. The slickrock and soil substrates interspersed in the cluster area strongly suggest that the bulk of the material pertains to the A.D. 800 period; erosion coupled with solar exposure on a southerly slickrock slope could easily have produced the greatly increased and relatively normal variance observed from a fairly homogeneous original scatter.

The greater temporal variance observed in the less weathered area of spatial cluster 2 probably could not have arisen from a single occupation; rather, a range of occupations, perhaps as many as six, dating from possibly 7,000 B.P. up to A.D. 1000, is indicated.

Spatial cluster 3 was composed entirely of bifaces, including a small but otherwise typical San Jose point (Figure 8.2E), dating to 2,150 B.C. All other items were of Basketmaker age.

Spatial cluster 4 was composed of a single Late Archaic biface fragment.

Overall, site LA 25480 evidenced a range of occupations spanning the first millennia A.D. and B.C., with sporadic earlier elements. The variable site taphonomy of the collected area probably indicated that finer temporal resolution is justified.

7.5.5 Site LA 25532

From this site, located roughly equidistant between major Piedra Lumbre and Tewa sites (AR-4 and Palisade Ruin), 26 rinds were reported. These patterned in two spatial clusters (Figure 7.4) which essentially reproduced the field collection units. Seven temporal periods were detected, mostly pertaining to the period between A.D. 500 and A.D. 1650. Spatial cluster 1 (K-means clusters 1, 2, 5, 6, 11, 14, and 15) reflected one early date (3,100 B.P.) and a range from 750 B.P. to 1,500 B.P. for 11 cuts on points, tools, and debitage. Spatial cluster 2 (K-means clusters 3, 4, 7, 8, 9, 10, 12, and 13) exhibited the same temporal occupation, plus two Tewa/Piedra Lumbre occupations (A.D. 1630 and A.D. 1440) and two isolated En Medio/Basketmaker dates on dart-arrow point fragments (Figures 8.4G and 8.4H).

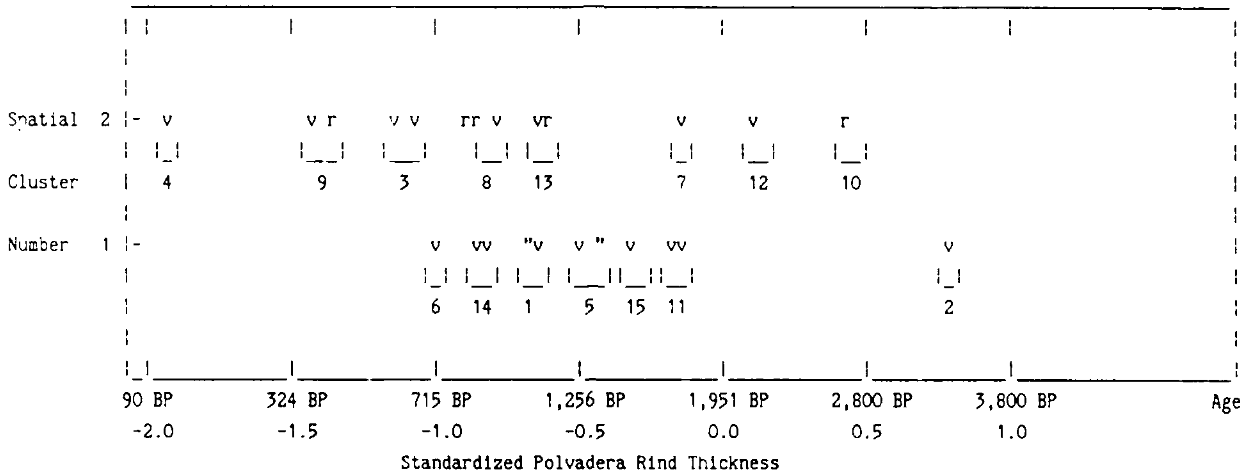
7.5.6 Site LA 27002

Based on nine cuts, no spatial patterning could be resolved. All items except one isolate, but including an En Medio or Thoms (1977) type 26 point, pertained to the late Late Archaic or early Basketmaker periods; the isolate was a slightly larger point base of similar type dating to 3,900 B.C. (Figures 8.4I and 8.4J). Perhaps this last piece is better referred to Thoms' type 7.

7.5.7 Site LA 27018

This site, represented by 35 cuts, presented six spatial clusters corresponding fairly well to the spatial divisions suggested by Kuhn (Chapter 10); two to four main temporal clusters were represented.

Figure 7.4 Obsidian K-Means Analysis For Site LA 25532, Abiquiu Archaeological Study, 1989.



K-Means Cluster Numbers	Spatial Cluster	Range North	Range East	Notes
6, 14, 1, 5, 15, 11, 2	1	104-119	125-133	13 cuts (6 tool, 6 debitage, 1 point).
4, 9, 3, 8, 13, 7, 12, 10	2	124-129	101-113	13 cuts (10 tool, 2 debitage, 1 point).

Key

v = valid date

r = recycled earlier date

|_| = K-means cluster number
#

" = multiple dates

Spatial cluster 1 displayed a wide range of dates from Middle Archaic to Basketmaker times, including an Abiquiu Eared (Thoms 1977) or Navajo (Schaafsma 1979) point dating to 5,500 B.P. with reuse and haft damage at 4,500 B.P.; and two very large, thick, stemmed points of Thoms' (1977) type 14, 15, or 20 dating to 3,600 B.P. and A.D. 480, respectively (Figures 8.4B-D).

Spatial cluster 2 consisted of only one item, dating approximately 3,500 B.P. and recycled at 2,800 B.P.

Spatial cluster 3 consisted of only one item, dating approximately 2,400 B.P. and recycled at about 1,800 B.P.

Spatial cluster 4 consisted of tools and debitage; the primary temporal cluster(s) either lie at or bracket A.D. 640.

Spatial cluster 5 (Figure 7.5) consists of only an En Medio point (Figure 8.4F); the two K-means clusters are probably overseparated, suggesting a true date of around A.D. 1040.

Spatial cluster 6 consists of two large points of Thoms' (1977) type 14, 15, or 20. These pieces have a recycled date of 400 B.C. and a reuse or manufacturing mean date of A.D. 676; they are typologically and metrically similar to the cluster 1 points and to points from LA 25328 (Figures 8.4A and 8.4E). It is likely that these large, thick, carefully worked pieces may have functioned as heavy-duty lance or spear points throughout the Archaic and perhaps into Puebloan times (cf. Lord and Cella 1986).

7.5.8 Site LA 27020

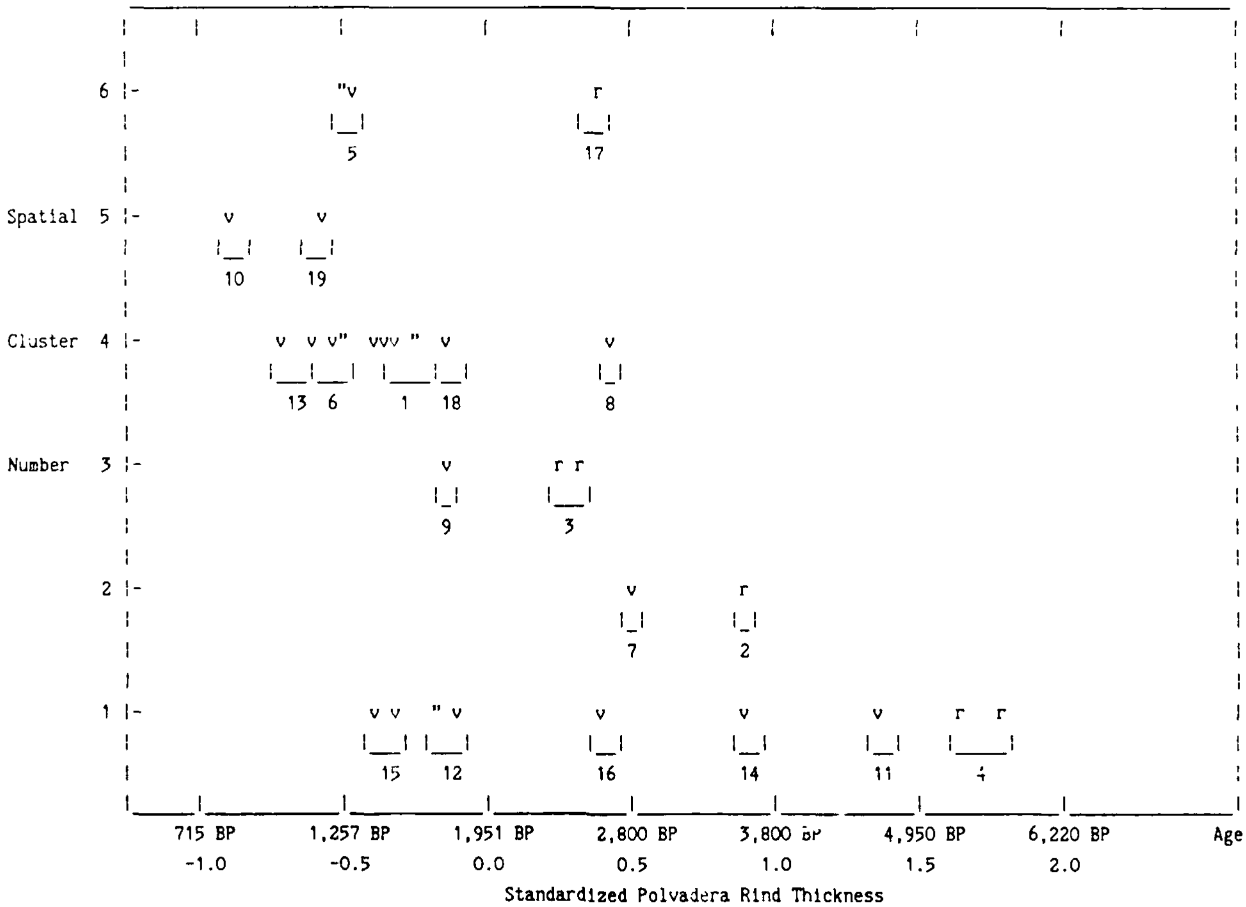
No spatial clusters were isolated for this sample of eight cuts; dates (Figure 7.6) ranged from 1,200 B.C. to A.D. 1106. This last date was on a complete Tesuque Narrow Base (Thoms [1977] type 35) or Basketmaker III point (Figure 8.1E).

7.5.9 Site LA 27041

From this site, 28 cuts were reported by Stevenson (Appendix B) and sourced by Hughes (Appendix A). K-means analysis (run for from four to 12 clusters) suggested the presence of several overlapping spatiotemporal clusters. Excluding an isolated artifact, all are poorly segregated (Figure 7.7). Obsidian appears to be rather randomly spatially distributed with respect to cluster structure, although clusters 5, 6, and 7 may reflect spatiotemporal subdivisions.

For this site as for LA 27018, an alternative analysis was employed which recognized the homogeneously north-northwest trending slope of the site. East coordinates w ignored; all items were plotted by north coordinate against standardized equivalent rind thickness (Figure 7.8). This figure indicates the presence of a general trend for thinner (i.e., more recent) rinds to lie at the north extreme of the site, and for thicker rinds to lie to the south.

Figure 7.5 Obsidian K-Means Analysis For Site LA 27018, Abiquiu Archaeological Study, 1989.



K-Means Cluster Numbers	Spatial Cluster	Range East	Notes
4,11,12,14,15,16	1	122-132	10 cuts (1 tool, 4 debitage, 5 point).
2,7	2	151	2 tool cuts.
3,9	3	7	3 tool cuts.
1,6,8,16,18	4	100-110	3 tool cuts, 10 debitage cuts.
10,19	5	117	2 point cuts.
5,17	6	170	4 point cuts.

Key

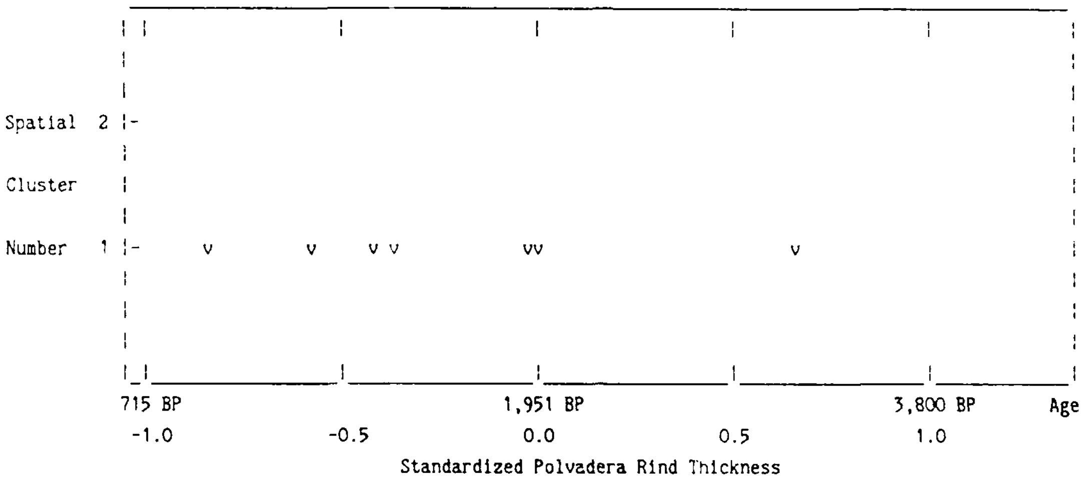
v = valid date

r = recycled earlier date

|_| = K-means cluster number
#

" = multiple dates

Figure 7.6 Obsidian K-Means Analysis For Site LA 27020, Abiquiu Archaeological Study, 1989.



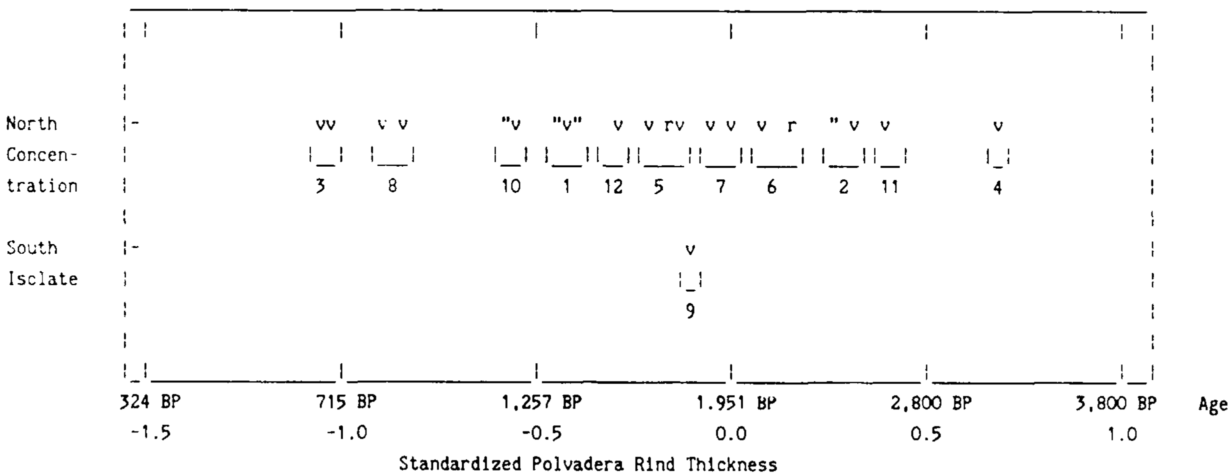
Key

v = valid date

r = recycled earlier date

" = multiple dates

Figure 7.7 Obsidian K-Means Basic Analysis For Site LA 27041, Abiquiu Archaeological Study, 1989.



K-Means Cluster Numbers	Range North	Range East	Notes
4	125	112	1 debitage cut.
11	124	114	1 debitage cut.
2	124-125	108-112	3 cuts (2 tool, 1 debitage).
6	125	108-114	2 cuts (1 tool, 1 debitage).
7	118-125	111-117	2 tool cuts.
9	129	101	Isolated point cut.
5	125	108-111	3 cuts (2 tool, 1 debitage).
12	124	114	1 debitage cut.
1	125-129	107-114	5 cuts (1 tool, 2 debitage, 2 point).
10	125-129	108-112	4 cuts (2 tool, 2 debitage).
8	124-129	110-114	2 debitage cuts.
3	124	114	2 debitage cuts.

Key

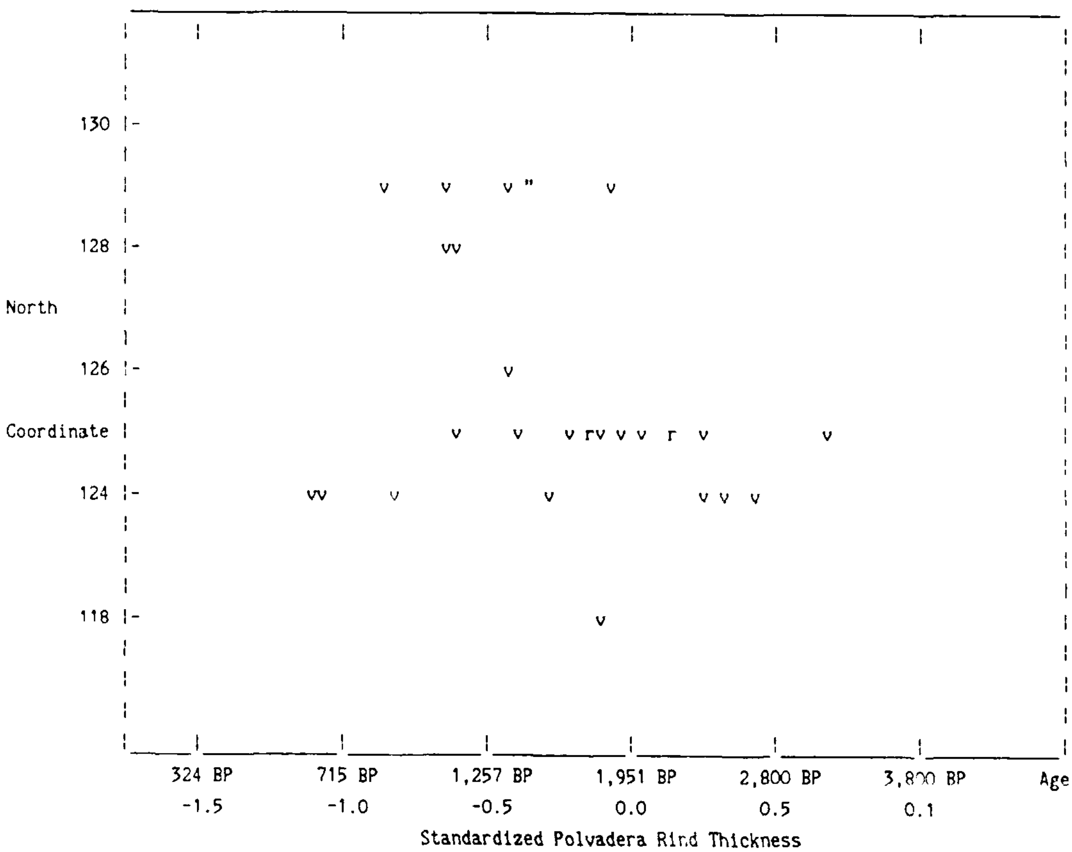
v = valid date

r = recycled earlier date

|_| = K-means cluster number
#

" = multiple dates

Figure 7.8 Obsidian K-Means Slope/Trend Analysis For Site LA 27041, Abiquiu Archaeological Study, 1989.



Key

v = valid date

r = recycled earlier date

" = multiple dates

The northern edge of the collection unit on this site lay on a steep cobble slope, shaded by trees, while the southern edge of the obsidian scatter lay on eroding fine sediments on a gentler slope in the open. The northern debitage has probably always experienced far less morning sunshine, has been shaded earlier in the afternoon, has lain under more snow, and has been eroded by slurry wash for far longer than have the southerly fragments.

All of these factors tend to ensure that the northern items will exhibit less hydration than would be expected for their age, but more rind erosion, while the southern items will have experienced faster hydration due to sun exposure and less rind erosion due to less energetic sheet washing.

Consequently, the author suspects that obsidian from the northern part of LA 27041 is older than its rinds imply, and that LA 27041 southerly obsidian is younger and less variable than lab observations suggest.

7.5.10 Site LA 27042

Analysis of this site employed 34 cuts on three spatial proveniences and two isolates (Figure 7.9).

Spatial cluster 1, located on an isolated dune crest, was thought, during field analysis, to be a single-component site. Obsidian analysis revealed the presence of three to five valid temporal clusters, including total stratigraphic inversion in the test pit subsurface obsidian samples. Ages ranged from Late Archaic through Pueblo III times; a possible Early Archaic piece was recycled.

Spatial cluster 2 included 14 cuts on tools, points, and debitage; it exhibited dates extending across a slightly earlier range comparable to spatial cluster 1, except that no Puebloan dates were observed. A point was observed approximating the Arroyo Hondo subconcave type 11 (Thoms 1977) dating at 2,500 B.C. with reuse at A.D. 684 (Figure 8.3N).

Spatial cluster 3 produced debitage dates of A.D. 300 on three cuts.

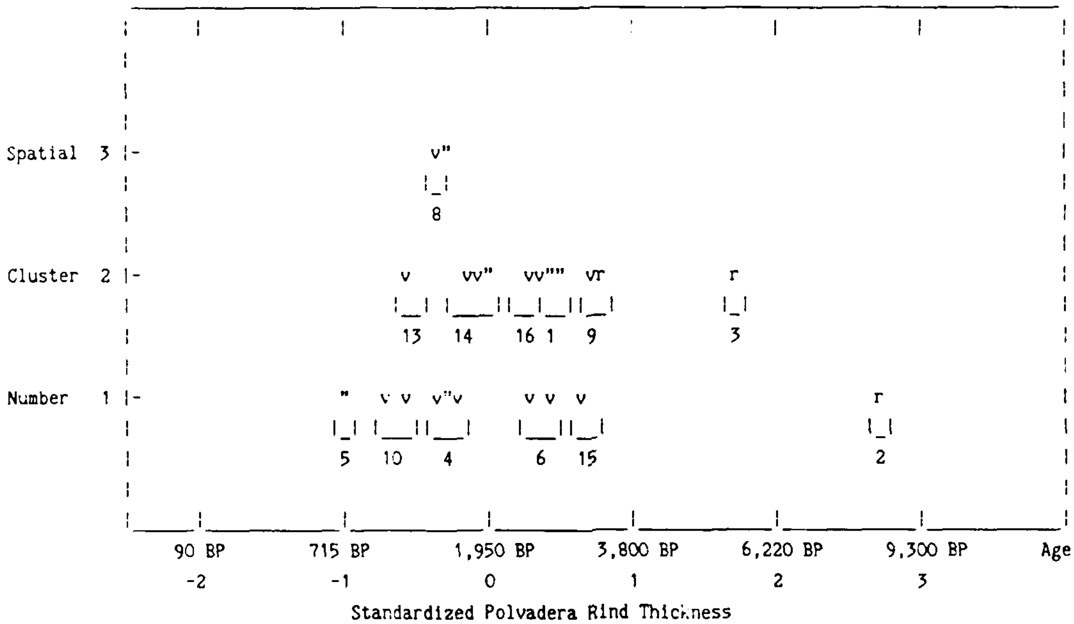
Isolated points included a point intermediate between the Arroyo Hondo and Abiquiu types (Thoms 1977) dating at 320 B.C. (Figure 8.3L) and a point or preform fragment dating to 170 B.C. (Figure 8.3M); both items are large and side-notched, as was the cluster 2 Arroyo Hondo-like point.

The remarkable spread of dates in spatial cluster 1, a small, apparently isolated, single-component, undeflated scatter, serves as a cautionary tale to field analysts. The stratigraphic inversions may reflect a cool subsurface versus sun-heating or perhaps mixing; whatever the interpretation, spatial cluster 1 is multicomponent.

7.5.11 Site LA 51698

Analysis of the 10 cuts provided by Stevenson (Appendix B) indicated the presence of no clear spatiotemporal clusters; rather, items appeared to per-

Figure 7.9 Obsidian K-Means Analysis For Site LA 27042, Abiquiu Archaeological Study, 1989.



K-Means Cluster Numbers	Spatial Cluster	Range North	Range East	Notes
2, 15, 6, 4, 10, 5	1	240-244, 308-309	271-273, 286-299	14 cuts (1 tool, 13 debitage).
3, 9, 1, 16, 14, 13	2	270-310	285-299	12 cuts (5 tool, 5 debitage, 2 point).
8	3	363	300	2 point cuts.

Key

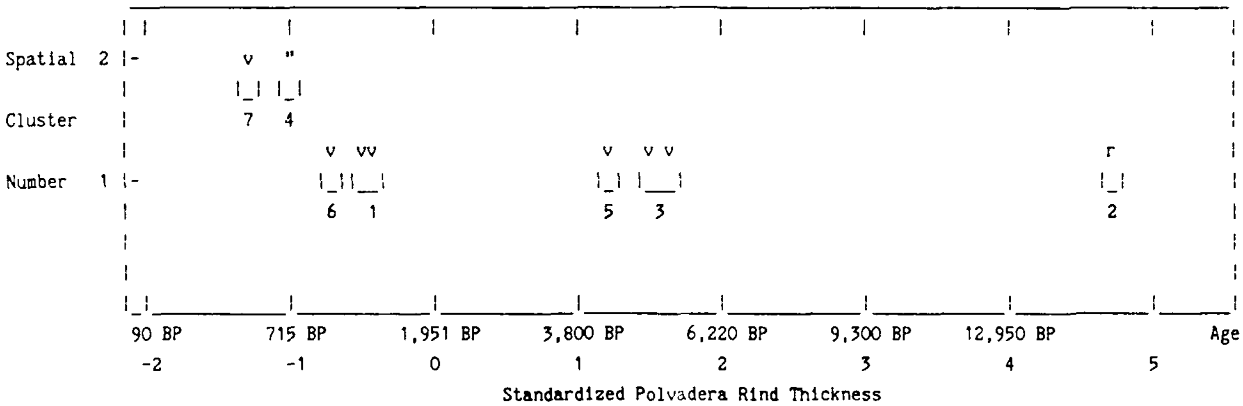
v = valid date

r = recycled earlier date

¦_¦ = K-means cluster number
#

" = multiple dates

Figure 7.10 Obsidian K-Means Analysis For Site LA 51698, Abiquiu Archaeological Study, 1989.



K-Means Cluster Numbers	Spatial Cluster	Range North	Range East	Notes
1	1	[illegible]-104	90-93	Surface and subsurface, 2 cuts (1 debitage, 1 point).
2	1	100	100	Point cortex from old cobble (1 cut).
3	1	100-104	90-100	1 point and 1 debitage cut.
4	2	117-119	116-135	1 point cut, 1 tool cut.
5	1	102	91	1 debitage cut.
6	1	104	90	1 debitage cut.
7	2	119	135	1 point cut.

Key

v = valid date

r = recycled earlier date

|_| = K-means cluster number
\#

" = multiple dates

tain to a range of time periods (Figure 7.10). What seems to be reflected in the spatial segregation between spatial clusters 1 and 2 is a temporal difference, in that spatial cluster 2, based only on a tool cut and two cuts from an En Medio point (Figure 8.1I), indicates tools manufactured or reworked around A.D. 1300 were discarded, possibly by the users of the hearth (Feature 2) which was dated at 890 $\pm$ 60 B.P. and 620 $\pm$ 70 B.P. (uncorrected) by radiocarbon analysis (University of Texas 5514 and 5508).

Spatial cluster 1 spatially constituted the rest of LA 51698; it exhibited sparse evidence of occupations during Middle and Late Archaic times and again during Basketmaker and possibly Pueblo I times.

Two points associated with this spatial cluster were typologically obscure. Specimen 1 (Figure 8.1H) appeared to be a small, corner-notched point which, due to inclusions, could not be successfully thinned; it probably represented a drill and dated to 3,700 B.C. It was made of a cortical flake from a cobble whose surface was probably first exposed around 14,000 B.C. Alternatively, this item may have experienced accelerated hydration due to roasting, etc. A second point (Figure 8.1J), from Level 2 of subsurface deposits in Feature 3, was hydration dated at A.D. 350; it appears to represent a failed preform for a broad, thin point of Thoms' type 11, 12, or 28. It was associated with a radiocarbon date of 3,510 $\pm$ 120 B.P. (University of Texas 5510) from an underlying ash dump stratum (Level 3); the dates may not be inconsistent if the preform were consistently buried or abraded. Obsidian debitage (two pieces) from the carbon-dated level (3) gave dates of A.D. 830 and 4,300 B.C., consistent with neither the point preform nor the radiocarbon date.

7.5.12 Site LA 51700

From this site, Stevenson (Appendix B) reported 21 rinds, which K-means analysis resolved into two spatial clusters and perhaps three temporal clusters (Figure 7.11). All but one artifact were successfully sourced; the exception was a projectile point (Figure 8.3D).

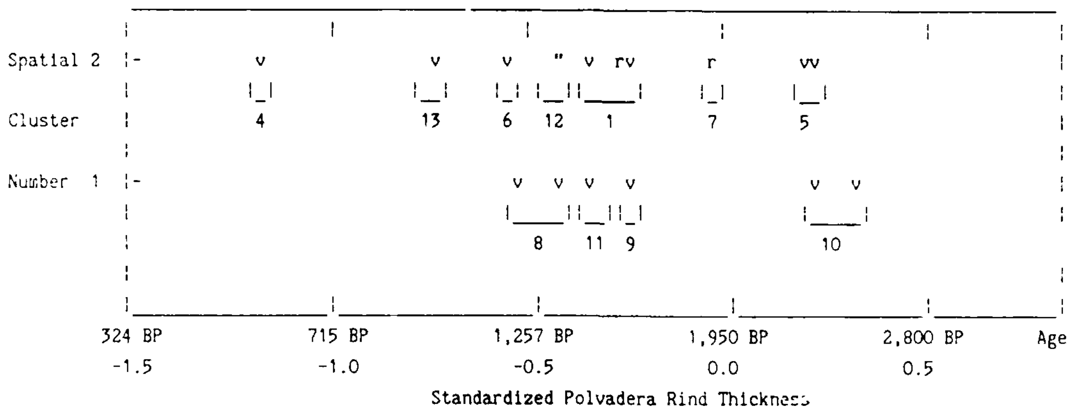
Spatial cluster 1, corresponding to Proveniences 1 and 4 (Unit 1), contained a Late Archaic thick point, probably Thoms' type 15 (Figure 8.3B), and a point fragment and two debitage items pertaining to Basketmaker occupation. The debitage items were recovered from Levels 1 and 2 of Provenience 4 (N316/E293); their dates suggest stratigraphic inversion.

Spatial cluster 2, corresponding to Provenience 3 (Unit 2), produced a tool of Tewa age, a Basketmaker to Pueblo II cluster or clusters, and a definite and possible En Medio point (Figures 8.3C and 8.3D), both probably Late Archaic.

7.6 CONCLUSIONS AND IMPLICATIONS

The MAI-ACOE obsidian samples revealed significant and surprising trends. Although abbreviated, the obsidian study presented in this chapter is sufficient to support rather strong conclusions.

Figure 7.11 Obsidian K-Means Analysis For Site LA 51700, Abiquiu Archaeological Study, 1989.



K-Means Cluster Numbers	Spatial Cluster	Range North	Range East	Notes
10	1	320	290	Point, probably Thoms' type 15 (2 point cuts).
5	2	343-344	306-307	1 point (En Medio?) and 1 tool cut.
7	2	343	303-304	Point-undated, and tool (2 point and 1 tool cut).
8,9,11	1	316-323	293-301	2 undiagnostic point frag., 2 subsurface debitage.
3	Singleton	295	204	1 tool cut.
1,6,12, 13	2	343-348	301-309	7 cuts (2 tool, 5 debitage).
4	2	344	301	1 tool cut.

Key

v = valid date

r = recycled earlier date

|_| = K-means cluster number
#

" = multiple dates

It appears that spatially restricted, single-occupation loci are rare at Abiquiu Reservoir. In most sites, obsidian from all important occupation periods was present at most loci sampled.

Obviously intact, clearly single-occupation, single-function loci probably are not intact or single-occupation. At LA 27042, an isolated, uneroded, technologically coherent, pure obsidian assemblage proved to exhibit the same or almost the same depth and varying intensity of occupation as the entire site, or of all the sites studied.

Obviously eroded, surficial, transported, mixed assemblages may often prove to retain great spatial and temporal coherence. The most coherent "single-occupation" obsidian assemblage in this study proved to be one of the "downhill" loci from LA 27018, spatial cluster 4, which had great integrity in spite of its location at the downhill end of an artifact-littered slickrock slope. Moreover, Kuhn's (see Chapter 10) study of the taphonomy of this site indicates that a combination of size-shape analysis, abrasion analysis, and hydration dating would permit the reconstruction of many of the original artifact spatial patterns on this site. Let it be remembered that Bertram opted to collect a downhill transect on LA 27018 because of his certainty that all of the artifacts had been sheet washed.

Typological projectile point studies appear to indicate, for obsidian points at least, that the general Oshara sequence is simplistic, if similar point morphology indicates similar function. The Oshara sequence is further evaluated in Chapter 8.

Very large, well-made points are apparently characteristic of local subsistence strategies from PaleoIndian times until the Coalition Period, or later.

Wide, palmate points, often side-notched, appear in the Middle Archaic and persist well into the first millennium A.D. These tools do not indicate Cochise or McKean or Desert influence; they, like the big, thick points, are technological variants, coexisting with the typical Osharan sequence.

Potential for big game (bison, elk) drive-hunting was always present together with medium game (deer, antelope, sheep) hunting and small animal (rabbits, etc.) hunting. It is to be expected that a range of knives, lance points, spear points, dart points, and (later) arrow points should be characteristic of cultures at all time periods, within the Abiquiu/Chama context. It seems rather inappropriate to argue that cultural factors caused some people to produce points which were the functional equivalent of Early Archaic or PaleoIndian pieces (if overall shape is ignored and consideration is given to only haft width, haft thickness, cross section, and workmanship) while other people, for cultural reasons, made the similarly shaped, but far smaller En Medio/Basketmaker dart points. Surely these tool differences reflect different aspects, or different targets, or different technologies within a single adaptation.

The same arguments follow for other aspects of lithic technology as well.

In summary, the research reported in this chapter suggests the following conclusions:

- Obsidian surface scatters sometimes can be recomposed into culturally meaningful study assemblages, using hydration analysis.

- It is doubtful that nonobsidian assemblages can be so recomposed, even if they are found in undisturbed subsurface context, on technological grounds alone.

- Using point typology as a chronometric tool is wasteful and circular (see Chapter 8 for a different view). Points and other tools are technological documents; their chronological placement is probably not well correlated with their typology, but their age and typology together may finally permit modeling the small game strategies of early hunters, and the PaleoIndian-like big game strategies of much later groups.

- Sites should be studied through multistage collection, with hydration analysis and unconstrained cluster analysis carried out before the second collection stage.

- National Register of Historic Places eligibility criteria for obsidian-bearing sites are therefore inappropriate, insofar as deflated sites retain great analytical potential for relatively low recovery cost.

8.0 CHRONOLOGY

Amy C. Earls, Christopher R. Lintz, and W. Nicholas Trierweiler

This chapter presents the results of the chronological studies. The chapter contains a discussion of obsidian recycling and C-14 dates as well as point and ceramic type cross-dates for the 18 sites in the project area. Point illustrations are provided in section 8.3 although certain obsidian artifacts are referenced in section 8.1. Dates from chronometric samples and cross-dated types are compared in the final section. This chapter provides the basis for the discussion of Abiquiu occupations in Chapter 12.

8.1 OBSIDIAN RECYCLING

Chapter 7 presented results of the obsidian hydration study and definition of spatiotemporal clusters representing occupations or groups of occupations. Section 8.1 looks only at multiple obsidian readings. The obsidian dates presented in Chapter 7 (Table 7.1) are discussed relative to other chronometric and cross-dated artifact type dates in section 8.5.

Recycling was examined on 42 artifacts from 12 sites for which more than one cut was made or more than one rind thickness was read (the latter situation occurred when the rind at the selected location was variable in thickness). Table 8.1 provides laboratory numbers for the multiple cuts, provenience information (unit and grid square), artifact type, the obsidian date range based on one standard deviation from the mean date, and notes whether or not the date ranges for different cuts overlap. Where dates of different cuts or rind readings overlap, the differences in rind thickness are attributable to measurement errors or insignificant rind attrition. Differences in rind thickness are probably indicative of recycling only when the date ranges do not overlap. By this classification, six (14 percent) of the 42 artifacts with multiple readings do not indicate any evidence of recycling. Artifact types not recycled are two points (one from LA 27018 and one from LA 27042), two of three cuts on an early preform biface from LA 25330, two unifaces (one from LA 25330 and one from LA 25480), a marginally retouched tool on LA 27042, and a dart point or preform from LA 25480.

Recycled artifacts are discussed by artifact type within each of the sites. Difference in years between multiple cuts on one artifact are considered, as well as cut location for illustrated formal tools. Results are listed in Table 8.2. The difference in years reported in this table is an average figure for grouped artifact types on each site with recycled obsidian (i.e., with a "No" in the overlap column in Table 8.1).

When artifact types across all sites are averaged, a significantly longer period between recycling events on debitage as opposed to tools is evident. The difference between multiple cut readings on grouped debitage (n=6; the 86-316 figures are not included because of probable noncultural origin indicated by 27,000 B.C. age) averages 2,146 years. For bifaces (n=14), this figure is 550 years; for points (including one biface/point; n=9), 606 years; and for other tools (marginally retouched tools, drills, and unifaces; n=6), 272

Table 8.1 Recycled Obsidian, Abiquiu Archaeological Study, ACOE, 1989.

CRMD Lab Number	Provenience (Unit-NGrid-EGrid)	Artifact Type	Date Range	Overlap in Date Range	Figure Number
LA 25328:					
86-361	4-45-84	Debitage	A.D. 31-69	No	
86-361	--[1]	Debitage	A.D. 802-860		
86-365	3-53-152	Flake	374-292 B.C.	No	
86-365	--	Flake	1,263-1,165 B.C.		
86-367	1-153-55	Flake	2,293-2,127 B.C.	No	
86-367	--	Flake	A.D. 87-143		
86-705	2-105-125	Biface/Point	A.D. 398-466	No	
86-706	--	Biface/Point	A.D. 321-373		
86-719	3-52-152	Flake	1,202-1,132 B.C.	No	
86-719	--	Flake	A.D. 251-303		
86-734	9-x-x[2]	Biface	A.D. 750-810	No	
86-734	--	Biface	A.D. 1236-1272		
86-765	3-55.15-145.50	Early Preform Biface	A.D. 909-965	No	
86-765	--	Early Preform Biface	597-489 B.C.	No	
86-765	--	Early Preform Biface	A.D. 356-390	No	
LA 25330:					
86-694	1-103-100	Uniface	A.D. 1152-1190	Yes	
86-695	--	Uniface	A.D. 1134-1184		
86-754	1-106-107	Marginal Retouch	A.D. 1243-1275	No	
86-755	--	Marginal Retouch	A.D. 1109-1133		
86-762	1-100-118	Early Preform Biface	A.D. 635-697	No	
86-763	--	Early Preform Biface	A.D. 170-224	No	
86-763	--	Early Preform Biface	A.D. 627-689	Yes	
LA 25333:					
86-710	1-104-118	Uniface	A.D. 78-170	No	
86-711	--	Uniface	142-66 B.C.		
LA 51698:					
86-851	4-119.40-135	Point	A.D. 1441-1481	No	8.1I
86-852	--	Point	A.D. 1265-1311		8.1I
LA 25480:					
86-307	1-394-333	Debitage	16 B.C. - A.D. 40	No	
86-307	--	Debitage	A.D. 1606-1646		
86-316	1-419-330	Debitage	27,804-27,362 B.C.	No	
86-316	--	Debitage	A.D. 347-399		
86-678	1-398-334	Uniface	A.D. 867-909	Yes	
86-679	--	Uniface	A.D. 858-958		
86-707	1-418-333	Late Preform Biface	A.D. 1177-1225	No	
86-708	--	Late Preform Biface	A.D. 838-868		
86-773	2-394-302	Early Preform Biface	A.D. 944-984	No	

Table 8.1 (Continued).

CRMD Lab Number	Provenience (Unit-NGrid-EGrid)	Artifact Type	Date Range	Overlap in Date Range	Figure Number
<u>LA 25480</u>:					
86-774	--	Early Preform Biface	A.D. 643-689	No	
86-774	--	Early Preform Biface	A.D. 1128-1152	No	
86-838	4-364.90-299.40	Preform	A.D. 690-750	Yes	8.2H
86-839	--	Preform	A.D. 689-735		8.2H
<u>LA 27018</u>:					
86-684	1-101-151	Early Preform Biface	1,485-1,385 B.C.	No	
86-685	--	Early Preform Biface	A.D. 683-751		
86-745	2-145-7	Biface Blank	426-302 B.C.	No	
86-746	--	Biface Blank	A.D. 330-382	No	
86-746	--	Biface Blank	242-162 B.C.	No	
86-751	1-103-106	Biface Blank	A.D. 787-861	No	
86-752	--	Biface Blank	A.D. 874-902		
86-813	1-111.4-170.9	Point	A.D. 758-802	Yes	8.4A
86-814	--	Point	A.D. 765-795		8.4A
86-817	1-105.10-126	Point	A.D. 441-507	No	8.4C
86-818		Point	A.D. 627-659		8.4C
86-821	1-106.90-117.18	Point	A.D. 881-923	No	8.4F
86-822	--	Point	A.D. 1147-1195		8.4F
86-823	1-111.40-170.90	Point	A.D. 674-736	No	8.4E
86-824	--	Point	468-406 B.C.		8.4E
<u>LA 27020</u>:					
86-843	1-106.85-103.05	Point	A.D. 666-712	No	8.1C
86-844	--	Point	A.D. 860-902		8.1C
<u>LA 27041</u>:					
86-703	1-125-108	Early Preform Biface	93-35 B.C.	No	
86-704	--	Early Preform Biface	A.D. 398-466	No	
86-704	--	Early Preform Biface	A.D. 923-965	No	
86-739	1-123-111	Biface Blank	A.D. 197-233	No	
86-740	--	Biface Blank	A.D. 490-540		
86-829	1-129.98-114.51	Point	A.D. 697-727	No	8.4K
86-830	--	Point	A.D. 735-779		8.4K
<u>LA 27042</u>:					
86-299	2-244-273	Flake	5,834-5,720 B.C.	No	
86-299	--	Flake	A.D. 468-532		
86-692	3-297-301	Marginal Retouch	364-262 B.C.	Yes	
86-693	--	Marginal Retouch	374-272 B.C.		
86-726	9-308.5-244.5	Early Preform Biface	A.D. 415-465	No	
86-727	--	Early Preform Biface	728-684 B.C.		
86-871	3-363-300	Point	232-172 B.C.	Yes	8.3L

Table 8.1 (Continued).

CRMD Lab Number	Provenience (Unit-NGrid-EGrid)	Artifact Type	Date Range	Overlap in Date Range	Figure Number
LA 27042:					
86-872	--	Point	262-202 B.C.		8.3L
86-875	9-x-x	Point	2,391-2,251 B.C.	No	8.3N
86-876	--	Point	A.D. 720-780		8.3N
86-757	1-128-112	Tool	A.D. 31-69	No	
86-758	--	Tool	A.D. 321-391		
LA 25532:					
86-688	1-124-109	Early Preform Biface	684-596 B.C.	No	
86-689	--	Early Preform Biface	A.D. 923-1019		
86-701	1-128-108	Biface Drill	A.D. 1109-1147	No	
86-702	--	Biface Drill	A.D. 531-597	No	
86-702	--	Biface Drill	A.D. 1038-1064	No	
86-715	1-128-107	Marginal Retouch	A.D. 1879-1893	No	
86-715	--	Marginal Retouch	A.D. 860-902	No	
86-716	--	Marginal Retouch	A.D. 1581-1597	No	
86-716	--	Marginal Retouch	A.D. 1121-1171	No	
86-722	2-118-129	Biface Drill	A.D. 712-758	No	
86-723	--	Biface Drill	A.D. 888-986		
86-768	2-114-125	Biface Blank	A.D. 944-984	No	
86-769	--	Biface Blank	A.D. 1096-1134		
LA 51700:					
86-854	1-323.61-301.50	Point	A.D. 456-508	No	8.3A
86-855	--	Point	A.D. 687-783		8.3A
86-856	9-320.60-290.61	Point	312-252 B.C.	No	8.3B
86-857	--	Point	447-405 B.C.		8.3B

[1] Indicates second or third reading on one item.

[2] Indicates NGrid/EGrid not available or not applicable.

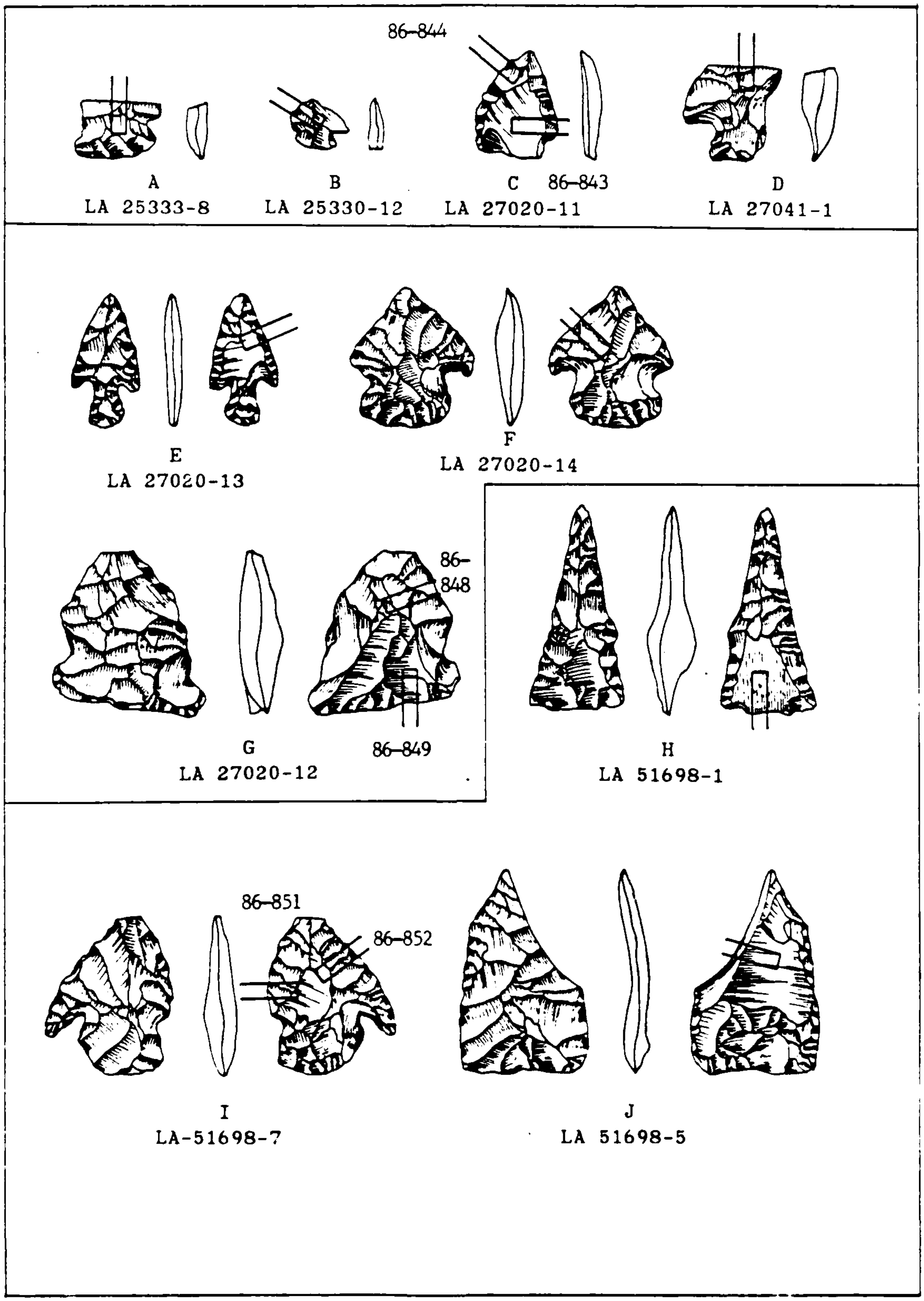
years. These figures, although dependent on sample sizes less than 10, show that length of period between recycling events averages less than 700 years for tools and that the period for debitage is over three times as long. Given the small sample sizes, the differences between points, bifaces, and other tools are not considered meaningful.

Table 8.2 Difference in Years of Artifact Types with Multiple Obsidian Cuts, Abiquiu archaeological Study, ACOE, 1989.

Site	Artifact Type	Number of Artifacts	Difference in Years
LA 25328	Debitage	4	1,358
LA 25328	Bifaces	3	680
LA 25330	Tools	2	300
LA 25333	Uniface	1	228
LA 51698	Point	1	173
LA 25480	Debitage	1	1,614
LA 25480	Tools	2	411
LA 27018	Bifaces	3	301
LA 27018	Points	3	527
LA 27020	Point	1	192
LA 27041	Tools	3	408
LA 27042	Debitage	1	6,277
LA 27042	Bifaces	2	1,617
LA 27002	Tool	1	306
LA 25532	Nondrill Tools	3	922
LA 25532	Drills	2	383
LA 51700	Points	2	136

Table 8.1 should be compared with section 8.3 to correlate dates with cut locations on the eight illustrated points with multiple cuts. Artifact 7 (86-851/852) from LA 51698, an En Medio point, shows a difference of 173 years between the A.D. 1288 date on the intact blade on one side and the A.D. 1461 date on the resharpening of the broken barb on the opposite side (Figure 8.1I). Artifact 28 (86-817/818) from LA 27018, a San Jose/En Medio point, shows a 169-year difference between the A.D. 474 date on the base and the A.D. 643 date on the haft, suggesting that this point was possibly rehafted (Figure 8.4C). Artifact 6 (86-821/822) from LA 27018, an En Medio point, shows a 269-year difference between the A.D. 902 date on the base and the A.D. 1171 date on a distal blade portion (Figure 8.4F). Artifact 2 (86-823/824) from LA 27018, a San Jose/En Medio point, features a 1,142-year difference between the 437 B.C. date on the haft element and the A.D. 705 date on the snap above the haft (Figure 8.4E). Artifact 11 (86-843/844) from LA 27020, an unidentified small point, shows a 192-year difference between the A.D. 689 date on a proximal portion of the blade and the A.D. 881 date near the tip (Figure 8.1C). There is a small, 45-year discrepancy between the A.D. 712 date on the mid-

Figure 8.1 Projectile Points from LA 25333, LA 25330, LA 27020, LA 27041, and LA 51698, Abiquiu Archaeological Study, ACOE, 1989.



Scale=1:1

Figure 8.2 Projectile Points from LA 25480, LA 27041, and LA 25328 (artifacts F, I, K, and L are not obsidian), Abiquiu Archaeological Study, ACOE, 1989.

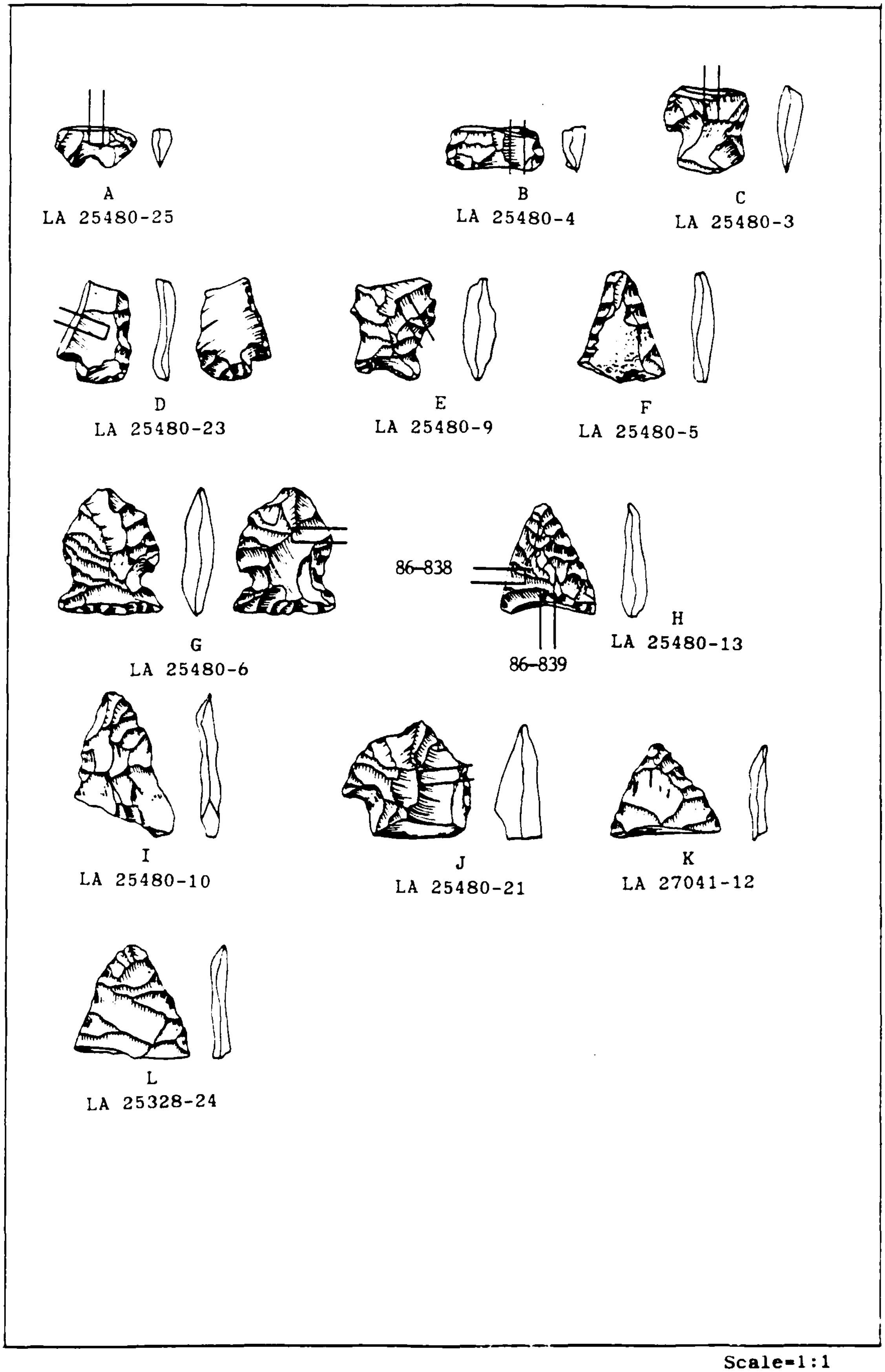


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Figure 8.3 Projectile Points from LA 51700, LA 25328, and LA 27042, Abiquiu Archaeological Study, ACOE, 1989.

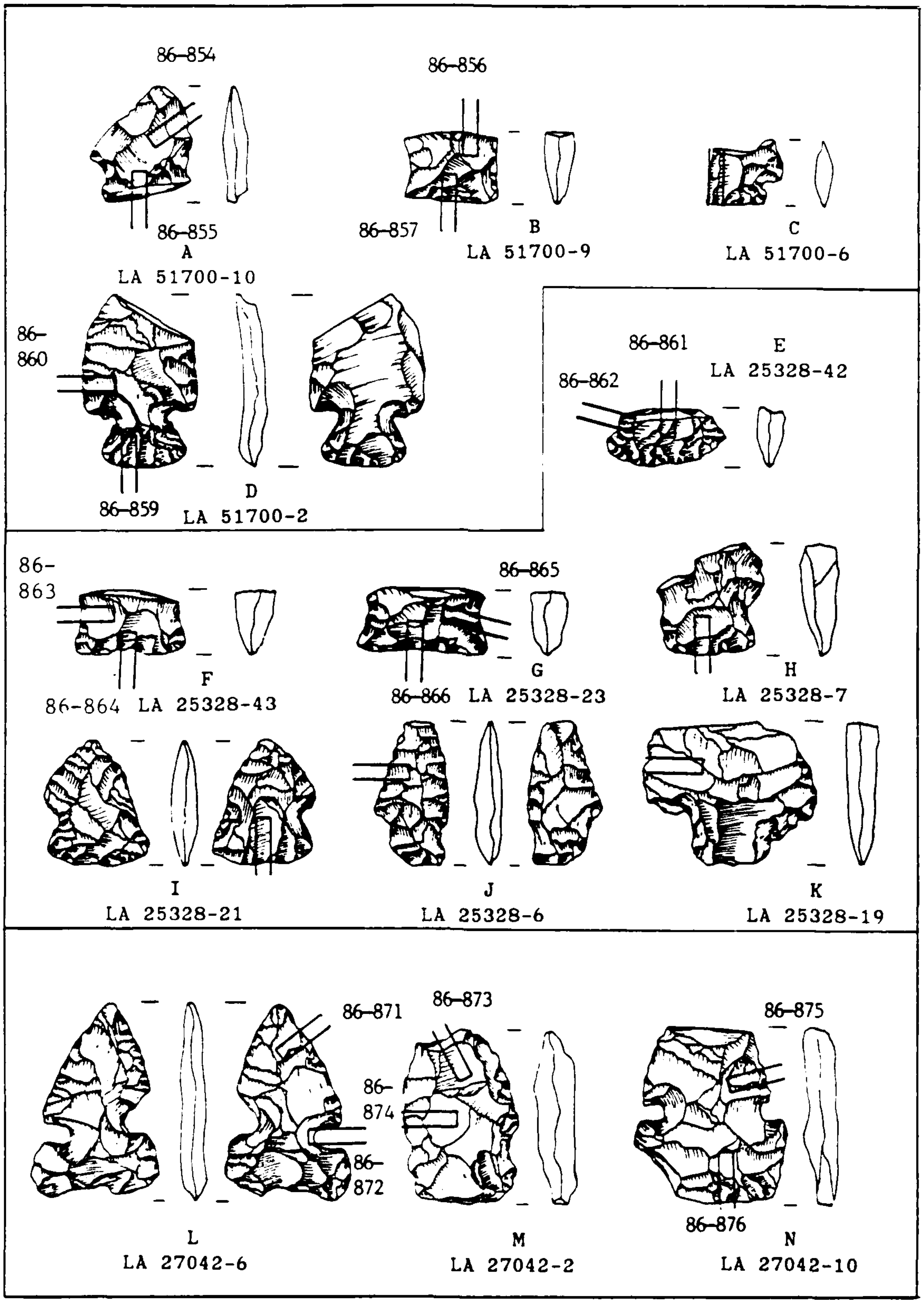

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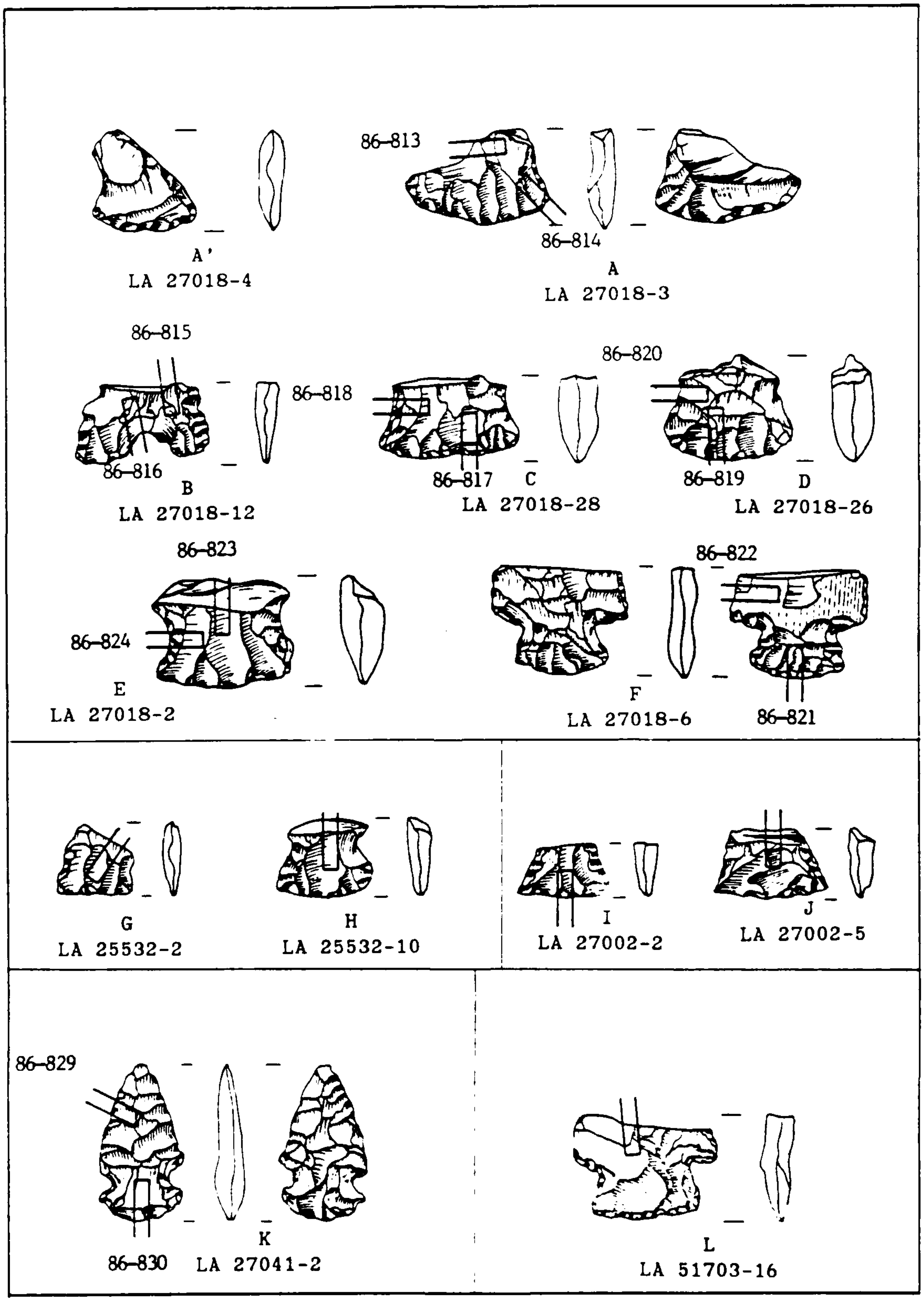
Figure 8.4 Projectile Points from LA 27018, LA 25532, LA 27002, LA 27041, and LA 51703 (artifact A' is not obsidian), Abiquiu Archaeological Study, ACOE, 1989.



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blade of Artifact 2 (86-829/830) from LA 27041 and the A.D. 757 date on the base (Figure 8.4K); although the standard deviations do not overlap, these dates probably both refer to the manufacturing period. Artifact 10 (86-875/876) from LA 27042, untyped in the Oshara system, has a 3,071-year difference between the 2,321 B.C. date on the distal blade above the high notch and the A.D. 750 date on the base (Figure 8.3N). Artifact 10 (86-854/855) from LA 51700, an unidentified dart point, shows a difference of 253 years between the A.D. 482 date on the blade below the oblique tip break and the A.D. 735 date on the basal break (Figure 8.3A). Artifact 9 (86-856/857) from this same site, an unidentified point, shows a difference of 144 years between the 426 B.C. date on the base and the 282 B.C. date on the transverse blade fracture (Figure 8.3B).

To summarize the above recycling patterns for points, meaningful length of period between dated cuts ranges from 169 to 3,071 years, but only two of these periods are greater than 269 years. Four of eight cases (50 percent) showed significant differences in age between the earlier blade and the resharpened barb, the tip, the base, or the basal break. Three of eight cases (38 percent) showed significant differences in age between the earlier base and either the haft, the blade, or a blade fracture. The final specimen showed that the haft predated the snap above the haft. These figures indicate that recycling was not uncommon on these assemblages. Since Cerro del Medio specimens were excluded because the rinds cannot be well dated at this time and multiple cuts were not read on many points, the true incidence of long-term reuse of these points may be greater than indicated by this sample of eight illustrated points. At the same time, the dates are encouraging because they do not show counterintuitive patterns, such as major transverse breaks predating cuts on the haft or base. In other words, the patterns of recycling are in the right direction.

Patterns of recycling in the Abiquiu Reservoir lithic assemblage discussed here confirm patterns observed in Chapter 7 that obsidian discards were intensively reused, with intervals between new flaking or resharpening episodes as long as 3,071 years. The results were compared with the smaller sample from three cobble ring sites northwest of the project area (Earls et al. 1989). There was a tendency in the cobble ring site sample for flakes that were dated to have longer periods between use than points and bifaces. The magnitude of the difference was less than in the present study, reaching 400-700 years maximum. There was a moderate trend for haft/notch dates to be later than blade edge and tip breakage dates, possibly indicating that some items were used as projectiles, then hafted or rehafted for use as a knife or cutting tool. In the present study, the trend was for blade edges to predate projections, which may or may not be resharpened; the base tended to be the second oldest point portion after the blade.

8.2 C-14 DATES

Ten C-14 samples were submitted to the University of Texas at Austin Radiocarbon Laboratory, and nine were dated (the tenth sample was too small to date). Three samples from LA 27020 and six samples from LA 51698 were dated. All dates are from subsurface contexts. Table 8.3 provides uncorrected C-14 dates.

Table 8.3 Uncorrected C-14 Sample Proveniences and Results, Abiquiu Archaeological Study, ACOE, 1989.

LA/UT Sample Number	Provenience	Date B.P.	Date B.C./A.D.	Comments
25330/ 5513	N113/E124 Level 1	NA[1]	NA[1]	--
27020/ 5525	N110/E108 Level 1	50 $\pm$ 70	A.D. 1900 $\pm$ 70	Inside Piedra Lumbre structure, SW corner
27020/ 5516	N111.5/E109 Level 1	230 $\pm$ 70	A.D. 1720 $\pm$ 70	Near center of Piedra Lumbre structure, opposite SE wall opening
27020/ 5517	N107/E108 Level 1	260 $\pm$ 60	A.D. 1690 $\pm$ 60	Ash/charcoal/lithic area south of Piedra Lumbre structure
51698/ 5508	N118/E82-83 Feature 2/2A, Level 1	620 $\pm$ 70	A.D. 1330 $\pm$ 70	Basin-shaped hearth containing 3 early historical sherds and lithics
51698/ 5509	N98/E70 Structure 1, Level 1	1,150 $\pm$ 50	A.D. 800 $\pm$ 50	Pit outside and east of Piedra Lumbre structure
51698/ 5510	N104/E90 Feature 3, Level 3	3,510 $\pm$ 120	1,560 B.C. $\pm$ 120	Eroded hearth or hearth dump
51698/ 5511	N98/E69 Structure 1, Level 1	70 $\pm$ 60	A.D. 1880 $\pm$ 60	West side of Piedra Lumbre structure, 2 Valdito Micaceous sherds
51698/ 5512	N98/E70 Structure 1, Level 1	210 $\pm$ 70	A.D. 1740 $\pm$ 70	Pit outside and east of Piedra Lumbre structure
51698/ 5514	N118/E82-83 Feature 2, Level 2-3	890 $\pm$ 60	A.D. 1060 $\pm$ 60	Basin-shaped hearth with 3 early historical sherds

[1] Sample too small to date.

Reported C-14 dates use the 5568 (Libby) half-life and are corrected for C-12/C-13 ratio. Tree-ring corrected dates from the first consensus calibration (Klein et al. 1982) are provided in Table 8.4.

Table 8.4 Corrected C-14 Dates, Abiquiu Archaeological Study, ACOE, 1989.

LA Number	UT Sample Number	Provenience	Corrected Date
25330	5513	N113/E124	Not Available
27020	5515	N110/E108	A.D. 1670-1720, 1800-1935[1]
27020	5516	N111.5/E109	A.D. 1505-1675, 1710-1805[1]
27020	5517	N107/E108	A.D. 1490-1670, 1725-1795[1]
51698	5508	N118/E82-83	A.D. 1265-1405
51698	5509	N98/E70	A.D. 665-1015
51698	5510	N104/E90	2,150-1,665 B.C.
51698	5511	N98/E69	A.D. 1665-1765, 1790-1940[1]
51698	5512	N98/E70	A.D. 1515-1810, 1845-1880[1]
51698	5514	N118/E82-83	A.D. 1030-1250

[1] Multiple calendric intervals shown (two curve crossings).

The C-14 samples provided multiple dates for two Piedra Lumbre structures, one on LA 27020 in Comanche Canyon and one on LA 51698 on the Llano Piedra Lumbre to the north. Kemrer (1987) notes that Piedra Lumbre Phase sites date from A.D. 1630-1740 and attributes the remains to Tewa herders, with possible reoccupation by Hispanics, Pueblos, and other ethnic groups following the Piedra Lumbre Phase. Five of the six dates for the two structures fall within the above period, although the C-14 curve is complex for this recent period and several line crossings occur, making the date ranges rather broad. The single date that fell in the A.D. 665-1015 (Developmental) period was from a pit outside and east of the structure on LA 51698; another date from this same provenience was within the A.D. 1515-1810 or 1845-1880 period. The dates were fairly consistent for both interior and exterior proveniences with the Developmental Period exception noted above. One of the LA 51698 dates is from a context containing two Valdito Micaceous sherds; this date is discussed further in section 8.4.

Other C-14 dates are two close but not overlapping dates spanning parts of the Late Developmental, Coalition, and Classic Periods. These dates are A.D. 1265-1405 (Level 1) and A.D. 1030-1250 (Levels 2-3) for a basin-shaped hearth with historical sherds northeast of the Piedra Lumbre structure on LA 51698. The dates, though covering a fairly broad time span, are at least stratigraphically correct. A final San Jose or Armijo Phase date of 2,150-1,665 B.C. was produced from an eroded hearth or hearth contents on LA 51698

northeast of the Piedra Lumbre structure. C-14 dates are compared with other dates in section 8.5.

8.3 POINT TYPE DATES

The morphological complexity of projectile point size and shape is influenced by intended piercing, cutting, and hafting functions. In this study, all haftable bifaces with a sharp distal tip are considered to be points, regardless of whether they were used to tip arrow/dart/spear shafts, functioned as knives, or served as a combination of both activities. The shape/size of points is also affected by the technological aspects of tipping projectiles, the aerial dynamics and intended ballistic impact of the entire spear-dart-arrow shaft assemblage for projectile points, or the hafting and extent of cutting edge on knives. Studies have demonstrated that some morphological variability is sensitive to culturally based technological, functional, and stylistic patterns, which change or evolve through time. The study of point forms as temporal markers can, by extension, be used to delineate culture period affiliations.

This section uses cross-dating methods on point morphology as a basis for identifying the occupational ages of tested sites in the Abiquiu Reservoir area. Cross-dating of points is employed to complement the other absolute dates to increase the number of chronologically sensitive specimens from the sites and thus refine the occupational ages. The focus on points over other tool classes for cross-dating purposes is based on practical considerations: they are relatively abundant, they display wide stylistic variation, and more importantly they have been relatively well illustrated and described in archaeological reports of sites, and some have been dated by absolute methods.

The employed procedure does not attempt to create a point typology for the Abiquiu region, since the sample (n=73) is relatively small and preliminary typologies for north central New Mexico have been delineated in other studies (Thoms 1977, Irwin-Williams 1973, Lord and Cella 1986). Instead, the point morphology for individual specimens (illustrated in Figures 8.1-8.6) is compared to points from dateable contexts found elsewhere to obtain cross-dated age estimates for point forms. This comparative step places the points in a culture historical context and provides preliminary age estimates for the various point shapes. Next, the obsidian hydration results from select specimens are used to evaluate the validity of the cross-dated specimens. This step is critical in assessing the adequacy of the cross-dating methods for artifact types in the Abiquiu region.

8.3.1 Selected Point Attributes and Variables

The Abiquiu point sample used in this study consists of the 73 specimens from 12 sites which were illustrated; illustrations rather than actual artifacts were used in this study. A few other points listed in Appendix F but not illustrated are not included since the specimens were not available for reanalysis and the morphology is unknown. The total point sample includes nine complete specimens, 21 proximal stem fragments, 26 proximal stem and shoulder fragments, three medial fragments, five lateral fragments and nine distal fragments. The fragmentary condition of almost 88 percent of the

Figure 8.5 Projectile Points from LA 25480, LA 27018, LA 27020, LA 25328, LA 51701, LA 25333, LA 51698, and LA 51700, Abiquiu Archaeological Study, ACOE, 1989.

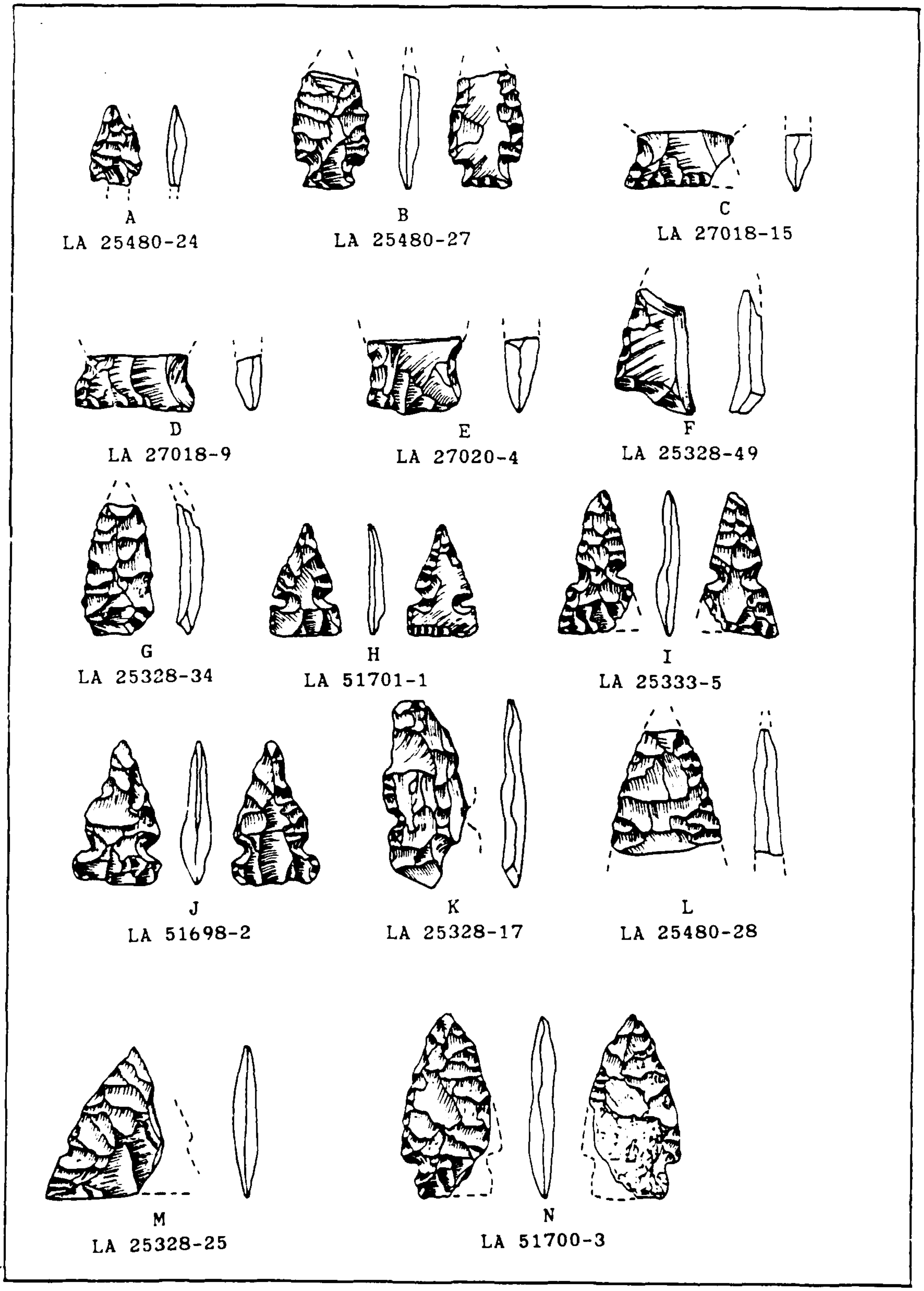

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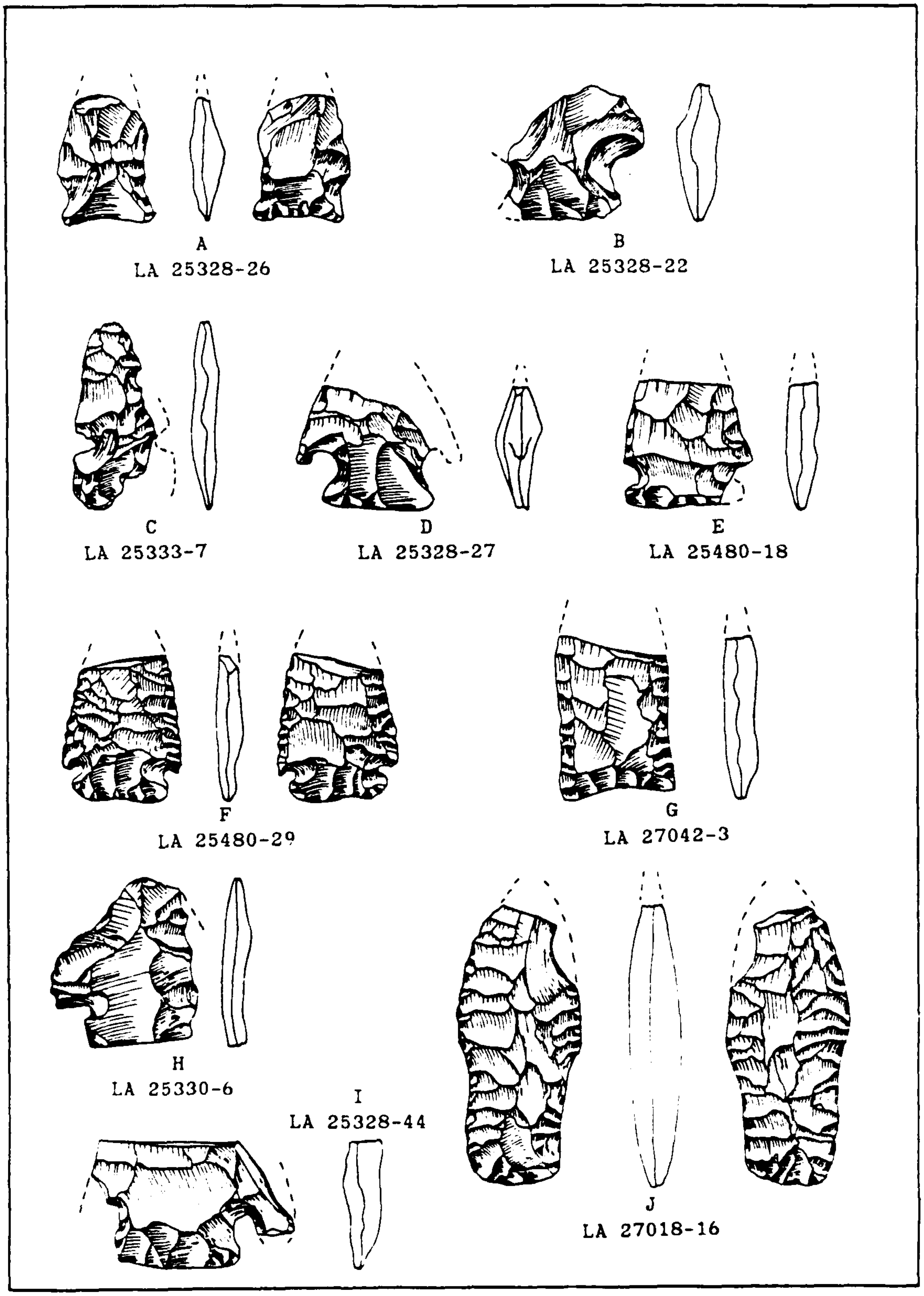
Figure 8.6 Projectile Points from LA 25328, LA 25333, LA 25480, LA 27042, LA 25330, and LA 27018, Abiquiu Archaeological Study, ACOE, 1989.



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points hinders their description and classification. The medial and distal point fragments are particularly difficult to deal with since nearly all of the crucial attributes are missing and the stem elements alone often do not indicate sufficient information to characterize the shoulder configuration. The loss of attribute observations limits the description and classification of points from the region.

The complex morphology of points mandates careful selection of critical analytical observations. In this study, the morphology attributes used to 'characterize the Abiquiu specimens follow a modified terminology developed by Anderson (1985). The specific terminology for portions of points and the range of attribute variation are graphically defined in Figures 8.7 and 8.8. Although numerous metric variables have been used to characterize points from other regions, only four were selected for this study: point length, width, thickness, and stem width. These variables are generally consistent with the critical measurements used by Bertram (1987) to technologically delineate arrow points (less than 10 mm haft width) from small dart (haft width range 10-15 mm) and large dart/spear points (greater then 16 mm). A portion of the present study evaluates the temporal trends suggested by Bertram (1987:5-55 to 5-66).

The dimensions of the 73 points are provided in Table 8.5. This table lists for each point the site and artifact specimen numbers, identified portion, select metric variables, and references to select illustrated specimens. The metric variables refer to observations delineated in Figures 8.7 and 8.8. The notation "S" or "B" following the width variable denotes that the widest portion of the point occurred at the shoulder or base.

The points display a wide range of morphological and metric variation (Figures 8.1-8.6). This tremendous range of variation coupled with small sample size precludes the independent development of morphological types, since many specimens are unique. Several generalizations are nevertheless possible. The point sample consists of notable morphological differences between the dart and arrow points. Dart points are dominated by specimens with biconvex cross sections, predominantly dull point tips, convex to straight blade edges, weakly barbed to unbarbed shoulders, slightly expanding to greatly expanding stem edges, broad and deep corner notches shallow side notches placed close to the base, pointed basal tangs, and mostly straight to slightly convex bases. A few of the dart points have long barbed shoulders (Figures 8.1I, 8.6D, and 8.6I), or have flanged stems with deep side notches with or without a deep basal notch (Figures 8.3L, 8.3M, and 8.4B). Only two specimens are unstemmed or weakly stemmed point forms (Figures 8.6G and 8.6J). The arrow points display a wider range of variation and include corner- and side-notched forms in approximately comparable proportions. The small corner-notched arrow points range from weak to prominent shoulder barbs, narrow to wide corner notches, straight to slightly expanding stems which range from long to short, pointed to rounded basal tangs, and straight to markedly convex bases. The side-notched forms uniformly have deep notches placed well up the side, flanged edges generally in line with the blade edges, pointed tangs, and straight bases. At least one small point has a poorly defined or unstemmed base (Figure 8.5G).

Table 8.5 Abiquiu Point Attributes, Abiquiu Archaeological Study, ACOE, 1989.[1]

Site No.	Artifact Number	Portion	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)	Figure Number
LA 25328	24	Distal Tip	(0)	(20)	(20)-	3	8.2L
LA 25328	42	Proximal Base	14	(10)	20 B	4	8.3E
LA 25328	43	Proximal Base	17	(12)	19 B	6	8.3F
LA 25328	23	Proximal Base	18	(10)	21 B	6	8.3G
LA 25328	7	Proximal Base	14	(17)	19 B	6	8.3H
LA 25328	21	Complete	13	22	17 B	4	8.3I
LA 25328	6	Proximal Base/Shoulder	8	(24)	13 S	5	8.3J
LA 25328	19	Proximal Base/Shoulder	12	(24)	30 S	5	8.3K
LA 25328	49	Medial Shoulder	(16)	(14)	(19)-	4	8.5F
LA 25328	34	Proximal Base/Shoulder	12	(23)	13 S	4	8.5G
LA 25328	17	Proximal Base/Shoulder	10	(33)	(15)-	4	8.5K
LA 25328	25	Lateral	0	28	(18)-	4	8.5M
LA 25328	26	Proximal Base/Shoulder	12	(22)	16 B	6	8.6A
LA 25328	22	Proximal Base/Shoulder	13	(23)	(23)S	7	8.6B
LA 25328	27	Proximal Base/Shoulder	0	(21)	(23)S	7	8.6D
LA 25328	44	Proximal Base/Shoulder	20	(22)	(36)S	6	8.6I
LA 25330	12	Proximal Base/Shoulder	6	(10)	(10?)S	2	8.1B
LA 25330	6	Lateral	17	28	(25)-	4	8.6H
LA 25333	8	Proximal Base/Shoulder	11	10	(16)-	4	8.1A
LA 25333	5	Lateral	7	25	(13)-	3	8.5I
LA 25333	7	Lateral	0	(32)	14 B	4	8.6C
LA 51698	1	Distal Tip	--	--	--	--	8.1H
LA 51698	7	Complete	11	27	(21)S	5	8.1I
LA 51698	5	Proximal Base/Shoulder	--	--	--	--	8.1J
LA 51698	2	Complete	10	25	15 B	4	8.5J
LA 25480	25	Proximal Base	(0)	(7)	14 B	3	8.2A
LA 25480	4	Proximal Base	(0)	(7)	13 B	4	8.2B
LA 25480	3	Proximal Base/Shoulder	9	(15)	15 S	4	8.2C
LA 25480	23	Proximal Base/Shoulder	9	(18)	13 S	3	8.2D
LA 25480	9	Proximal Base/Shoulder	10	(18)	16 S	5	8.2E
LA 25480	5	Proximal Base/Shoulder	(0)	(19)	(15)-	2	8.2F
LA 25480	6	Distal Tip	12	23	18 B	5	8.2G
LA 25480	13	Complete	(0)	(20)	(16)-	3	8.2H
LA 25480	10	Distal Tip	(0)	(28)	(15)-	3	8.2I
LA 25480	21	Distal Tip/Shoulder	18	(21)	23-	7	8.2J
LA 25480	24	Medial	4	(14)	9 S	3	8.5A
LA 25480	27	Proximal Base/Shoulder	7	(20)	13 S	3	8.5B
LA 25480	28	Medial	(0)	(21)	(19)-	5	8.5L
LA 25480	18	Proximal Base/Shoulder	18	(22)	23 S	4	8.6E
LA 25480	29	Proximal Base/Shoulder	14	(25)	20 S	3	8.6F
LA 27018	4	Proximal Base	14	(18)	(18)B	4	8.4A
LA 27018	3	Proximal Base	(0)	(22)	14 B	5	8.4A
LA 27018	12	Proximal Base	17	(13)	23 B	4	8.4B

Table 8.5 (Continued).

Site No.	Artifact Number	Portion	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)	Figure Number
LA 27018	28	Proximal Base	19	(13)	24 B	6	8.4C
LA 27018	26	Proximal Base	17	(18)	21 B	7	8.4D
LA 27018	6	Proximal Base	12	(18)	23 S	4	8.4F
LA 27018	2	Proximal Base	20	(18)	24 B	8	8.4E
LA 27018	9	Proximal Base	17	(10)	20 B	5	8.5D
LA 27018	15	Proximal Base	0	(10)	(17)B	5	8.5C
LA 27018	16	Proximal Base/Shoulder	17	(48)	21 S	8	8.6J
LA 27020	11	Distal Tip	6	(19)	14 S	3	8.1C
LA 27020	13	Complete	3	22	12 S	3	8.1E
LA 27020	14	Complete	12	24	21 S	5	8.1F
LA 27020	12	Proximal Base/Shoulder	20	(27)	22 S	8	8.1G
LA 27020	4	Proximal Base	14	13	(16)B	6	8.5E
LA 27041	1	Proximal Base/Shoulder	8	(17)	(18)S	6	8.1D
LA 27041	12	Distal Tip	(0)	(15)	(15)-	3	8.2K
LA 27041	2	Complete	9	27	14 B	4	8.4K
LA 27041	10	Proximal Base/Shoulder	17	(30)	(26)B	6	8.3N
LA 27041	3	Proximal Base/Shoulder	18	(28)	19 S	6	8.6G
LA 27002	2	Proximal Base	11	(9)	15 B	4	8.4I
LA 27002	5	Proximal Base	13	(12)	19 B	4	8.4J
LA 25532	2	Proximal Base	(0)	(12)	13 B	2	8.4G
LA 25532	10	Proximal Base	11	(13)	16 B	4	8.4H
LA 51700	10	Distal Tip/Shoulder	(0)	(18)	18 S	3	8.3A
LA 51700	9	Proximal Base	15	(13)	17 B	5	8.3B
LA 51700	6	Proximal Base	(0)	(14)	(12)S	3	8.3C
LA 51700	2	Proximal Base/Shoulder	9	(29)	20 S	4	8.3D
LA 51700	3	Lateral	0	32	(16)-	4	8.5N
LA 51700	1	Complete	0	26	35 B	6	8.5H
LA 51700	12	Proximal Base/Shoulder	0	(18)	10 S	3	8.4L

1 Key:

) - Incomplete/broken dimension.

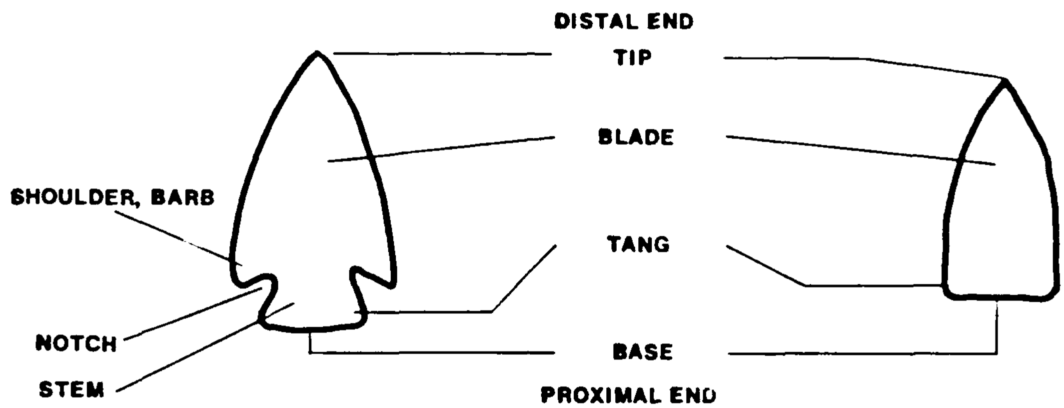
\- - Shoulder and/or base widest dimension.

B - Base widest dimension.

S - Shoulder widest dimension.

Figure 8.7 General Morphological Attributes and Measured Variables of Projectile Points, Abiquiu Archaeological Study, ACOE, 1989.

A. TERMINOLOGY



B. MEASUREMENTS

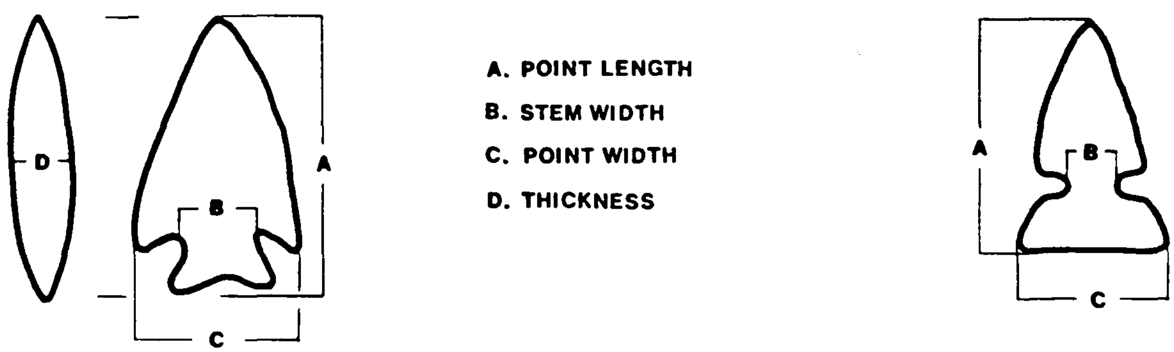
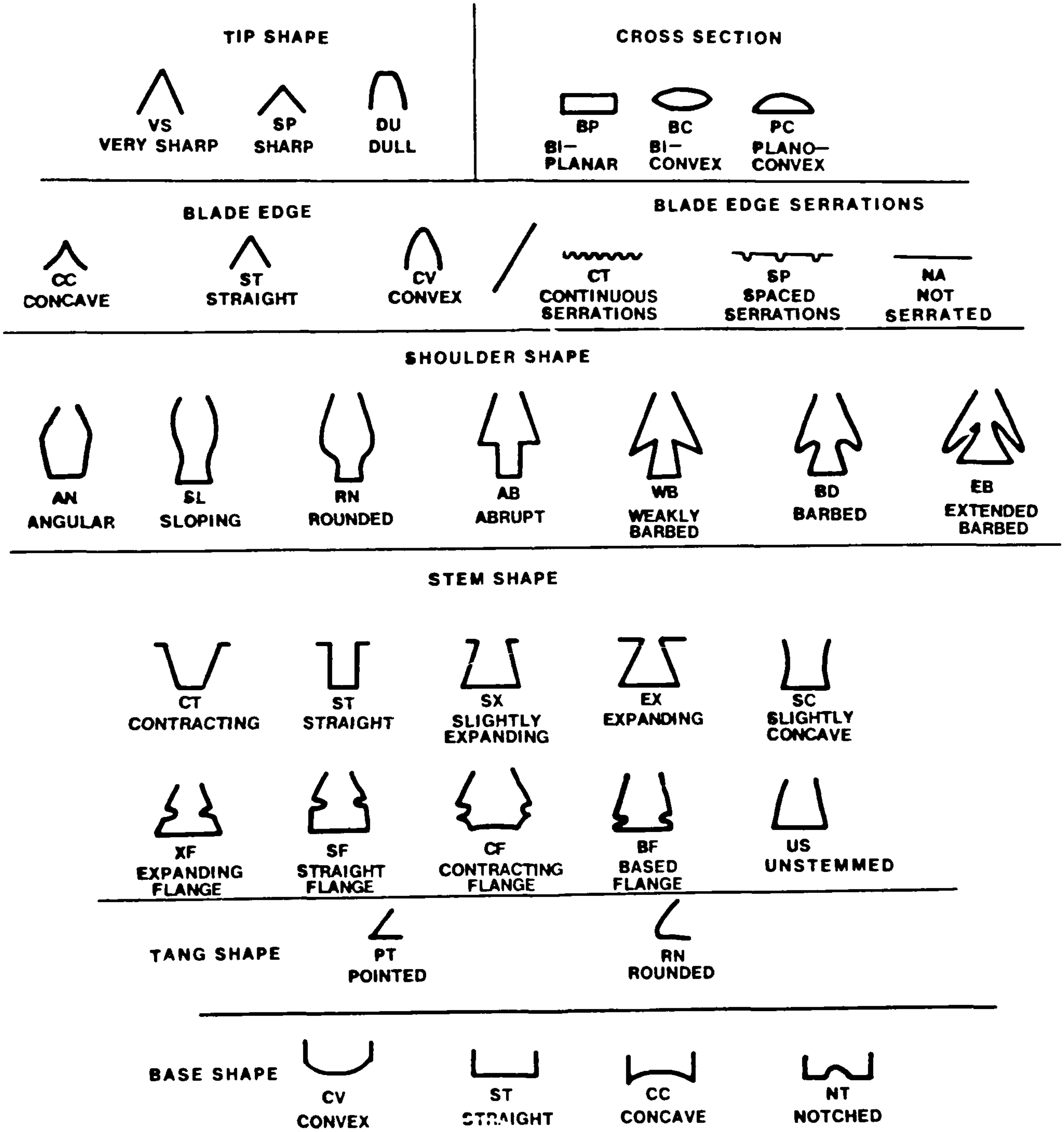


Figure 8.8 Projectile Point Attributes, Abiquiu Archaeological Study, ACOE, 1989.



ND NO DATA (BROKEN/MISSING)

NA NOT APPLICABLE (NEVER WAS)

The tremendous range of morphological variability among this class of artifacts may reflect 1) a poorly developed or generalized stylistic cultural template, 2) a wide range of functionally different hafted cutting and piercing tools, 3) a wide range of lost/discarded implements from various stages of resharpening/use, 4) examples from multiple occupations on stable land surfaces, 5) the prehistoric curation or collection of specimens from regional sites which represent a wide temporal span, or 6) any combination of the above. The comparison and cross-dating of similar point forms from a larger region provide data for assessing the relative number of components at these sites.

8.3.2 Comparisons and Cross-Dating

The cross-dating of the Abiquiu points was accomplished by comparing the recovered specimens with defined types and corresponding date estimates established for adjacent regions. Comparative regions include northwestern New Mexico (Irwin-Williams 1973), the northern Rio Grande (Thoms 1977), Abiquiu Reservoir (Lord and Cella 1986, Schaafsma 1976), and southeastern Colorado (Anderson 1985). The Colorado study was included because it contained a substantial data base (628 specimens) and was developed independently of the other southwestern sequences. Although the distance between Abiquiu Reservoir and southeastern Colorado may affect the cross-dating procedure, general trends are nevertheless evident between the two areas. The present section discusses underlying assumptions, methods, and results of the cross-dating procedure.

8.3.2.1 Assumptions

The basis for using cross-dating to date artifacts in a region is dependent upon a number of assumptions about cultural systems and the dynamics of those systems. Other assumptions underlie the methodological procedures involved in artifact classification and comparison.

The use of chipped stone artifacts for cross-dating is hampered by attempts to create relatively static morphological types from single examples produced from a dynamic process. Since flint-knapping is a subtractive manufacturing process, the resulting morphology of a point may reflect solitary examples from a series of complex processes perhaps involving one or more linear manufacturing trajectories. Simply restated, sometimes objects break during manufacture and are discarded before they reach their finished form, or extensive use of completed tools engenders wear or resharpening that further modifies the final form. Any knapping errors caused by inherent properties of the stone and/or artisan skill/motor habits/judgement which could not be overcome during manufacture or maintenance are also reflected in the morphology of the specimen. Clearly, considerable variation can occur in chipped stone artifacts made or used by a single individual during the same period that were designed to have the same morphology. To complicate the process, slight variation may arise from idiosyncratic knapping skills of different manufacturers or may occur in the replication of a specific form over a considerable period of time; subtle changes may reflect stylistic modifications in the mind of the maker or responses to technological changes involving other components of the tool or changes in the use of the point.

Archaeologists have no knowledge of the maker's intent and must infer activities from technological or wear damage patterns evident on individual objects. The tool typologies are developed from static examples of recovered remains which are imposed on subsequently found artifacts. The classification of artifacts often entails a multivariate approach which ultimately defines or pigeonholes objects into discrete (and hopefully replicable) types from the prehistoric technological and temporal dynamic systems. The assemblage size and chance recoverery of artifacts available for study often influence the structure of tool classification schemes and the delineation of types developed for a project-specific assemblage.

Another factor affecting the development of a typology is the relative weight placed on different attributes. The significance of slight variation, at some point, becomes critical. How much variation can occur before two objects are placed in separate types/varieties? No simple answer exists; however, provisional types should be tested for their usefulness in distinguishing temporal differences, and the types must be replicable.

Some attributes, such as point size, blade edge shape, and shoulder morphology, are apt to be modified more readily from the focus of frequent resharpening/retipping broken specimens than, for instance, the stem section which is stabilized inside the haft element. The differential treatment on parts of a single artifact suggests that some areas of the artifact are more amenable for typological analysis than others. Even though base and stem elements can occasionally become modified from shaft damage during impacts (Fennegin and Raymond 1986), the stem is most likely to reflect the original point form. To avoid the issue of morphological modifications which can occur throughout the use life of a specimen, most typological studies of points for north central New Mexico have conservatively approached point classifications. Irwin-Williams (1973), for instance, displays a range of forms attributable to various periods within the Osharan Tradition; Lord and Cella (1986, as modified by Bertram 1987) typically lump all large corner-notched points within a single type 06. Such an approach simplifies the classification issue, but the lumping of specimens obfuscates the temporal reality of various point types. Detailed attribute studies conducted in adjacent areas have demonstrated that fine morphological differences particularly in the base and stem are temporally sensitive and that the use of general morphological classifications often include forms used during several distinct time periods (Anderson 1985).

After the typology has been created, chronological ages must be assigned to specific types. To do this, the provenience and context of specimens relative to dated samples must be evaluated, since only the obsidian hydration method directly dates chipped stone obsidian artifacts. Most absolute chronometric methods rely on feature samples dated by tree-ring analysis, radiocarbon, archaeomagnetism, or other chronometric methods; and the contextual association of points to these dated features must be critically evaluated, as should be the reliability of the absolute date result. Few archaeological projects obtain a sufficiently broad suite of absolute dates in direct association with points to permit firm contextual correlation of all artifact types. More commonly, the association of materials is inferred by evaluating the stratigraphic context of the recovered points and the dated

feature. Under worst-case situations, archaeologists may erroneously infer single component utilization of a site based on the sparcity of material remains, and assume that all points (including those lacking stratigraphic context) are associated with dates, no matter how great the distance between the dated feature and the recovery locus for the classified artifact. Radiocarbon dates may even be erroneous from such factors as built-in age (old wood), cross section effect, or a series of other influences (cf. Smiley 1985). Under such circumstances, the artifact type may be erroneously dated.

Assuming that artifact styles have one or more periods of popularity, the tight contextual association of a point form to a dated feature still does not indicate the temporal range of popularity. The associated date must be used in conjunction with associated dates from other features to delineate the temporal range of common usage. The problems associated with dating style origins and extinctions are overwhelming. Thus time ranges reflect considered approximations.

To increase the number of specimens and types associated with dated contexts, a wider body of literature must be consulted. Some synthetic typological studies have already been compiled which have correlated specific forms to established ages for specimens over broad areas. Often such studies inadequately discuss the specimen-specific provenience and contextual problems. The range of point ages is strengthened when numerous dated sites consistently yield the same tool forms. One danger arises from extrapolating the age of point styles developed in a distant region to the local project. Extreme distance increases the possibility that cultural factors have impeded the transmission of styles. This cultural lag effect means that dates assignable from one region may not necessarily be contemporaneous with similar forms in another region.

Despite these problems inherent with cross-dating, the method has been widely used. The following section discusses the methods and results employed to cross-date the Abiquiu Reservoir study specimens. Results of this study are then compared with the obsidian hydration data from point forms in order to infer the number of occupations at these sites.

8.3.2.2 Methods

The method of developing cross dated age estimates for the 73 points relied on comparing illustrations of recovered specimens with illustrations of types from previous point sequences developed for northwestern New Mexico (Irwin-Williams 1973), for the northern Rio Grande (Thoms 1977), for Abiquiu Reservoir (Schaafsma 1976, Lord and Cella 1986), and for the southwestern Plains region (Anderson 1985). After corresponding point types were tentatively recognized, the point descriptions were consulted, if available, to ensure that the morphology and dimensions of the specimens were comparable. In some instances, one or more similar point styles were found, but the recovered specimens did not precisely match the illustration or description in every detail. In those instances, all comparable forms were listed, and those specimen types bearing a strong resemblance are indicated in Table 8.6 within parentheses if they did not precisely match the illustrated point from the Abiquiu collection.

Table 8.6 Projectile Point Types and Dates, Abiquiu Archaeological Study, ACOE, 1989.

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
25328-24	--	--	--	--	--	--	--	NA	8.2L
(unidentified large tip)									
25328-42	(Armijo/En Medio)	(14, 17, 21-25)	(06D, 06F, 10)	(P11, 20, 22)	2,800 BC-AD 1000	*	86-861A	CM	8.3E
	2,800 BC-AD 400	1,500 BC-AD 400	2,216 BC-AD 875	2,000 BC-AD 1000		*	86-861B	CM	8.3E
						*	86-862A	CM	8.3E
						*	86-862B	CM	8.3E
25328-43	En Medio	19, 15	06E, 12A, 12B, 13	(P13, 19)	3,000 BC-AD 1075	*	86-863	CM	8.3F
	800 BC-AD 400	1,000 BC-AD 400	1,782 BC-AD 1074	3,000 BC-AD 500		*	86-864	CM	8.3F
25328-23	Armijo/En Medio	20, 15	06F, 12A	(P23, 24, 37)		*	86-865	CM	8.3G
	2,800 BC-AD 400	1,000 BC-AD 400(1)	2,216 BC-AD 865	4,000 BC-AD 1000	4,000 BC-AD 1000	*	86-866	CM	8.3G
25328-7	--	--	--	--	--	AD 860+/-29	86-867	PV	8.3H
(unidentified dart point)									
25328-21	En Medio	14, 21-25	06, 10, 12A	P36	1,500 BC-AD 1200	*	86-868	CM	8.3I
	800 BC-AD 400	1,500 BC-AD 400	1,328 BC-AD 875	1,000 BC-AD 1200					

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
25328-6	--	27?/30? 1,000 BC-AD 550(1)	04 AD 500-1000s	P68, (P59) AD 600-1450	1,000 BC-AD 1450	932+/-46 BC	86-869	PV	8.3J
25328-19	--	(19) 1,000 BC-AD 400	--	--	1,000 BC-AD 400	292+/-51 BC	86-870	PV	8.3K
25328-49	--	--	--	--	--	--	--	NA	8.5F
25328-34 (small preform)	--	--	P71, P80 AD 950-1750	AD 950-1750	--	--	--	NA	8.5G
25328-17	--	28 4,000-400 BC	11 No hy. date	P47, 49 3,300-300 BC	4,000-300 BC	--	--	NA	8.5K
25328-25	--	20?, 22? 1,000 BC-AD 400	06?, 09? 1,800 BC-AD 1050	--	1,800 BC-AD 1050	--	--	NA	8.5M

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
25328-26	San Jose/Armijo 3,300-800 BC	6 4,000-800 BC	(6E), 7, 12A, 13 1,665 BC-AD 1074	P19(18) 3,100-500 BC	4,000-500 BC	--	--	NA	8.6A
25328-22	En Medio 800 BC-AD 400	15 1,250-500 BC	06A, 06F, 10 2,216 BC-AD 1033	P21, 22, 29 2,000 BC-AD 1000	2,216 BC-AD 1000	--	--	NA	8.6B
25328-27	En Medio 800 BC-AD 400	21, 22 1,000 BC-AD 400	06D, 06F 2,216 BC-AD 865	P28 500 BC-AD 1150	2,216 BC-AD 1150	--	--	NA	8.6D
25328-44	En Medio 800 BC-AD 400	21, 22 1,000 BC-AD 400	06D, 06F 2,216 BC-AD 865	P8 Unknown	2,216 BC-AD 865	--	--	NA	8.6I
25330-12	--	(34), (35) AD 500-1300	(4) AD 500-1000	(P63?) AD 500-1400	AD 500-1400	Rind not measurable	86-842	OR	8.1B
25330-6	--	(15) 1,000-500 BC	(6) 2,216 BC-AD 1033	(P7) 3,000-1,000 BC	3,000 BC-AD 1000	--	--	NA	8.6H

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
25333-8	Armijo/En Medio	23, 24, 25	4, 6C	P36	2,800 BC-AD 1200	AD 106+/-28	86-841	PV	8.1A
	2,800 BC-AD 400	1,000 BC-AD 400	100 BC-AD 1100	1,000 BC-AD 1200					
25333-5	--	42, 39	03	P86	AD 700-1700	--	--	NA	8.5I
		AD 700-1300+	AD 970-1700	AD 750-1650					
25333-7	--	28	(11)	(P47, 49)	4,000-300 BC	--	--	NA	8.6C
		4,000-400 BC	4,000-500 BC	3,300-300 BC					
51698-1	--	--	--	--	--	*	86-850A	CM	8.1H
						*	86-850B	CM	8.1H
51698-7	En Medio	17, 21, 22	6D	P43	800 BC AD 1600	AD 1461+/-20	86-851	PV	8.1I
	800 BC-AD 400	1,000 BC-AD 400	ca. AD 400	AD 600-1600		AD 1288+/-23	86-852	PV	8.1H
51698-5 (preform)	--	--	--	--	--	*	86-853	CM	8.1J

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
51698-2	--	39, 36, 42 AD 600-1300+	2, 3 AD 828-1657	86 AD 750-1650	AD 600-1650	--	--	NA	8.5J
25480-25 (small side-/corner-notched)	--	--	(4) (AD 500-1000)	(59, 36) (AD 400-1600)	AD 400-1600	Rind not measurable	86-832	CM	8.2A
25480-4	(San Jose-En Medio) 3,300 BC-AD 400	(7, 15, 21) 1,800 BC-AD 400	(6) 2,216 BC-AD 1033	(P13, 20) 3,000 BC-AD 1000	3,300 BC-AD 1000	AD 398+/-25	86-833	PV	8.2B
25480-3	En Medio 800 BC-AD 400	(23) 1,000 BC-AD 400	6A 1,799 BC-AD 1033	(P33, P70) 500 BC-AD 1350	1,800 BC-AD 1350	113+/-20 BC	86-834	PV	8.2C
25480-23	--	--	--	(P53, P59) AD 600-1350	AD 600-1350	AD 1090+/-26	86-835	PV	8.2D
25480-9	San Jose/Armijo 3,300-800 BC	5, 6 3,300-800 BC	7, 13 1,385 BC-AD 1074	P19 3,000-500 BC	3,300-500 BC	1,715+/-69 BC	86-836	OR	8.2E

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
25480-5	--	--	--	--	--	--	--	NA	8.2F
25480-6	Armijo/En Medio	7, (15)	(6A)	(P27, 31, 34, 37)	3,000 BC-AD 1000	AD 206+/-36	86-837	PV	8.2G
	2,800 BC-AC 400	3,000-500 BC	1,799 BC-AD 1033	1,050 BC-AD 1000					
25480-13	--	--	--	--	--	AD 720+/-30	86-838	PV	8.2H
(unidentified dart/preform)						AD 712+/-23	86-839	PV	8.2H
25480-10	--	--	--	--	--	--	--	NA	8.2I
(unidentified dart/preform)									
25480-21	(En Medio)	--	--	--	800 BC-AD 400	AD 712+/-30	86-840	PV	8.2J
	(800 BC-AD 400)								
25480-24	--	--	--	--	--	--	--	NA	8.5A
(unidentified small side-/corner-notched)									
25480-27	En Medio/Trujillo	30	4(6)	P53, 59, 68	AD 1-1450	--	--	NA	8.5B
	800 BC-AD 600	AD 1-550	Most AD 500-1000	AD 600-1450					

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
25480-28	--	--	--	--	--	--	--	NA	8.5L
(unidentified dart tip)									
25480-18	Armijo/En Medio	7, (16)	6F	P36	3,000 BC-AD 1200	--	--	NA	8.6E
	2,800 BC/AD 400	3,000 BC/AD 1	2,216 BC/AD 865	1,000 BC/AD 1200					
25480-29	(En Medio)	24	06E	P36	1,650 BC-AD 1200	--	--	NA	8.6F
	800 BC-AD 400	1,000 BC-AD 400	1,665 BC-AD 423	1,000 BC-AD 1200					
27018-4	--	--	--	--	--	--	--	NA	8.4A'
(unidentified fragment)									
27018-3	--	--	--	--	--	AD 780+/-22	86-813	PV	8.4A
						AD 780+/-15	86-814	PV	8.4A
27018-12	--	(11), 28	11	P47	4,000-300 BC	*	86-815	CM	8.4B
		4,000-400 BC	4,000-500 BC	3,000-300 BC		*	86-816	CM	8.4B

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
27013-16	Jay	--	15	--	6,000-4,800 BC	--	--	NA	8.6J
	5,500-4,800 BC		6,000-4,800 BC						
27020-11	--	--	--	--	--	AD 689+/-23	86-843	PV	8.1C
(unidentified small point)						AD 881+/-21	86-844	PV	8.1C
27020-13	--	(34, 35)	(4)	P54, 55	AD 500-1400	AD 1152+/-25	86-846	PV	8.1E
		AD 900-1300+	most AD 500-1000	AD 700-1400					
27020-14	En Medio	23, 24	6A	P30, 43	1,800 BC-AD 1600	AD 627+/-55	86-847	PV	8.1F
	800 BC-AD 400	1,000 BC-AD 400	1,799 BC-AD 1033	AD 500-1600					
27020-12	--	(15)	--	--	1,250-500 BC	932+/-58 BC	86-848	PV	8.1G
		1,250-500 BC				Rind not measurable	86-849	PV	8.1G
27020-4	San Jose-En Medio	15, 14	10, 12A	P9	1,500 BC-AD 1000	--	--	NA	9.5E
	3,000 BC-AD 400	1,500 BC-AD 1	1,328 BC-AD 874	1,000 BC-AD 1000					
27041-1	En Medio	(9), 19, 20, 24	6A, 6E, 6F	--	2,200 BC-AD 1000	AD 312+/-26	86-845	PV	8.1D
	800 BC-AD 400	1,000 BC-AD 400	2,216 BC-AD 1033						

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
27018-16	Jay	--	15	--	6,000-4,800 BC	--	--	NA	8.6J
	5,500-4,800 BC		6,000-4,800 BC						
27020-11	--	--	--	--	--	AD 689+/-23	86-843	PV	8.1C
(unidentified small point)						AD 881+/-21	86-844	PV	8.1C
27020-13	--	(34, 35)	(4)	P54, 55	AD 500-1400	AD 1152+/-25	86-846	PV	8.1E
		AD 900-1300+	most AD 500-1000	AD 700-1400					
27020-14	En Medio	23, 24	6A	P30, 43	1,800 BC-AD 1600	AD 627+/-55	86-847	PV	8.1F
	800 BC-AD 400	1,000 BC-AD 400	1,799 BC-AD 1033	AD 500-1600					
27020-12	--	(15)	--	--	1,250-500 BC	932+/-58 BC	86-848	PV	8.1G
		1,250-500 BC				Rind not measurable	86-849	PV	8.1G
27020-4	San Jose-En Medio	15, 14	10, 12A	P9	1,500 BC-AD 1000	--	--	NA	8.5E
	3,000 BC-AD 400	1,500 BC-AD 1	1,328 BC-AD 874	1,000 BC-AD 1000					
27041-1	En Medio	(9), 19, 20, 24	6A, 6E, 6F	--	2,200 BC-AD 1000	AD 312+/-26	86-845	PV	8.1D
	800 BC-AD 400	1,000 BC-AD 400	2,216 BC-AD 1033						

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
27041-12	--	--	--	--	--	--	--	NA	8.2K
(unidentified dart point tip)									
27041-2	Armijo/En Medio	23, (38)	3, 6A	P26	2,800 BC-AD 1700	AD 712+/-15	86-829	PV	8.4K
	2,800 BC-AD 400	1,000 BC-AD 1300+	1,799 BC-AD 1700	1,500 BC-AD 1000		AD 757+/-22	86-830	PV	8.4K
27042-6	--	11	9	P47-like	3,000 BC-AD 1000	202+/-30 BC	86-871	PV	8.3L
		1,500 BC-AD 300	1,757 BC-AD 1024	3,000-300 BC		232+/-30 BC	86-872	PV	8.3L
27042-2	Armijo/En Medio	15, 14	12A	--	2,800 BC-AD 500	64+/-29 BC	86-873	PV	8.3M
	2,800 BC-AD 400	1,500-500 BC	1,328 BC-AD 250			No Date	86-874	PV	8.3M
27042-10	--	12 (13)	9	P47-like	3,000 BC-AD 1000	2,321+/-70 BC	86-875	PV	8.3N
		1,500 BC-AD 300	1,757 BC-AD 1024	3,000-300 BC		AD 750+/-30	86-876	PV	8.3N
27042-3	--	1	--	P1	8,500-5,900 BC	--	--	NA	8.6G
		ca. 6,640 BC		8,500-5,900 BC					
27002-2	--	--	(6?)	(P51?)	2,200 BC-AD 1750	242 BC+/-20	86-827	PV	8.4I
(unidentified small point?)			(2,216 BC-AD 1033)	AD 800-1750					

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
27002-5	--	(20)	(6A-D?)	(P51)	1.800 BC-AD 1750	*	86-828	CM	8.4J
		1,000 BC-AD 400	1,799 BC-AD 1033	AD 800-1750					
25532-2	--	--	--	--	--	AD 31+/-38	86-825	PV	8.4G
(unidentifiable)									
25532-10	--	(23), (27)	6A, 10	P22, 26, 70	1,800 BC-AD 1350	AD 780+/-22	86-826	PV	8.4H
		1,000 BC-AD 800	1,799 BC-AD 1033	1,500 BC-AD 1350					
51700-10	--	--	--	--	--	AD 482	86-854	OR	8.3A
(unidentifiable dart point?)						AD 735+/-48	86-855	OR	8.3A
51700-9	San Jose-Armijo	(8, 20)	(6, 12A)	P34, P37	3,300 BC-AD 900	282+/-30 BC	86-856	PV	8.3B
	3,300-800 BC	4,000 BC-AD 500	2,216 BC-AD 1033	500 BC-AD 900		426+/-42 BC	86-857	PV	8.3B
51700-6	--	33	(4)	--	AD 500-1250	212+/-30 BC	86-858	PV	8.3C
		AD 500-1250	ca. AD 500-1000						
51700-2	En Medio	23, 24	6A, (6F)	P22, 26, 70	2,200 BC-AD 1350	ND	86-859	ND	8.3D
	800 BC-AD 400	1,000 BC-AD 400	2,216 BC-AD 1033	1,500 BC-AD 1350		ND	86-860	ND	8.3D
51700-3	Armijo	9	6E, 6F	P59	2,800 BC AD 1000	--	--	NA	8.5N
	2,800-800 BC	1,000 BC-AD 200	2,216 BC-AD 865	AD 600-1200					

Table 8.6 (Continued).

LA Number	Irwin-Williams (1973)	Thoms (1976)	Lord/Cella (1986)	Anderson (1985)	Cross-Dates Time Span	Obsidian Hydration Dates	OH Lab Number	Obsidian Type	Fig.
51701-1	--	39, 42	3	P86	AD 700-1700	--	--	NA	8.5H
		AD 700-1300+	AD 968-1700	AD 750-1650					
51703-12	En Medio	(9), 15	6F	P20 (27)	2,000 BC-AD 1000	16,815+/-205 BC	86-831	PV	8.4L
	800 BC-AD 400	1,250 BC-AD 200	2,216 BC-AD 865	2,000 BC-AD 1000		(burned)			

* Hydration rate not available for Cerro del Medio

(1) Date in obsidian hydration report (uncorrected)

NA Not applicable (not obsidian)

ND No data (obsidian not sourced)

PV Polvadera obsidian

OR Obsidian Ridge obsidian

CM Cerro del Medio obsidian

The study of projectile points in this chapter was undertaken by Christopher Lintz independently of Jack Bertram's identifications. All type names used in this chapter and in Chapter 12 for cross-dating sites are based on Lintz's descriptions. All type names used in Chapters 6 and 7 and in Appendix E are based on Bertram's descriptions. In many cases the typological classifications by the two authors produced similar results. Bertram's Oshara and Thoms' type names for each point are listed in Appendix E, and Lintz's are given in tables in this chapter. A correspondence table of Thoms' point names and numbers is also provided in Appendix E. A tabular comparison of the two analysts' results is given in Appendix E. Although the analysts generally agreed on dart vs. arrow points and broad temporal ranges for the Abiquiu points, the inconsistency resulting from two separate studies is unfortunate but unavoidable, and perhaps emphasizes the subjectivity of the typologies involved.

Once the point styles were delineated, the corresponding age estimates of specimens in various sequences were obtained (Table 8.6). An examination of estimated age ranges reveals considerable agreement in beginning and ending dates for select point styles. This age congruence is not a result of independently validated chronologies, as much as it reflects the perpetuation by Schaafsma (1976), Thoms (1977), and to some extent Lord and Cella (1986) of age estimates from the Oshara Tradition sequence developed by Irwin-Williams. The tremendous influence of the Oshara Tradition data in formulating chronological sequences thoughout northern New Mexico may be unwarranted and certainly requires closer examination.

The Oshara Tradition is based on data derived from a six-year Anasazi origins project focused on the Arroyo Cuervo region of northwestern New Mexico (Irwin-Williams 1973). Six sequential phases spanning the Archaic through Basketmaker Periods have been delineated. The salient characteristics of site distributions, material content, and age estimates have been briefly delineated for each phase, but to date, little primary information is available to objectively assess specific details for most of the sequence (cf. Irwin-Williams and Tompkins 1968). Select point styles and other tools regarded as representative of each phase are illustrated by a single photograph (Irwin-Williams 1973), but no formal point typology exists for the entire sequence which provides fundamental descriptions, quantifications, or discussions about the range of variation. The provenience and context of project point styles remain unknown, as are lists of specific chronometric dates used to delineate the age of the phases. Although the Oshara Tradition is one of the few cultural constructs spaning the entire Archaic Period with readily definable attributes, the basis for defining characteristics of each phase and its chronological assignment cannot be evaluated.

Despite these drawbacks, subsequent researchers have utilized general point styles depicted for the Oshara Tradition to derive temporal and cultural assignments of other materials. Thus, the heterogeneous series of point styles assigned to a phase automatically became lumped together and assumed the name of that phase (cf. Schaafsma 1976). Typological studies by Thoms (1977) formally defined a series of types, but the temporal ranges were primarily based on the original Oshara Phase age estimates. Subsequent analyses

have refined and built on these studies, but the independent assessment of the regional chronology using obsidian hydration has only been initiated within the past five years (Lord and Cella 1986, Bertram 1987).

Table 8.6 indicates that 57 of the 73 Abiquiu points from 12 sites are tentatively classifiable by at least one typology. Because of the fragmentary nature of many specimens and the tendency for some schemes to lump a range of morphologically diverse forms together, some of the Abiquiu specimens correlate to one or more types. Individually, the Osharan point sequence had analogous forms for 34 specimens; the sequences developed by Thoms (1977) and Lord and Cella (1986) each generally classified 51 specimens, whereas that developed by Anderson for the western Plains had 48 analogous forms. The low number of corresponding types observed for the Osharan sequence is due to the general exclusion of small arrow points from the sequence. The perpetuation of the chronological sequences, as discussed above, has resulted in fair agreement in the age assessment of points for the Irwin-Williams (1973) and Thoms (1977) sequences. The Lord/Cella (1986) sequence frequently uses similar time ranges, but the occasional use of obsidian hydration data has resulted in some refinements. The point sequence developed by Anderson (1985) is more conservative in reflecting longer age estimate ranges, but nevertheless reflects divergence from the age estimates of the other schemes.

The cross-dating procedure suggests that all but two points date between 4,000 B.C. and A.D. 1750, with the most intensive occupational spans estimated to range from 3,000/2,200 B.C. to A.D. 1000 (Table 8.7, Figure 8.9). Only two sites, LA 27018 and LA 27020, had specimens predating 4,800 B.C. that would suggest that the cross-dated ages of points from the present sample span about eight millenia. Only five of 12 localities had more than three cross-dated specimens which which may indicate occupational ranges. The overlap in estimated time ranges for cross-dated specimens from LA 27013 and LA 51700 could be interpreted to reflect points made from single occupations, but the lack of overlap in age estimates for points from LA 25328, LA 25480, and LA 27020 reflects multiple occupational usage of the sites. Although the sample of cross-dated points is small for the other seven sites, multiple occupations are also suggested for the cross-dating of point styles from LA 25333. The reliability of these ocupational and age estimates and the recycling of points using obsidian hydration are evaluated in the section 8.5.

8.3.3 Chronological Evaluation

Forty-one points were directly dated by obsidian hydration methods; attempts to date three other specimens failed (Chapter 7, section 8.1). Thirty-two of these dated obsidian points were classifiable. The obsidian hydration results for these specimens were employed to independently evaluate the validity of the estimated age ranges provided by the cross-dating methods. Since the hydration rate for some obsidian sources is not well known, the reliability of some dates is not as good as that from others. In general, the confidence in the hydration results for the 26 points identified from the Polvadera source and the one date from the Obsidian Ridge source is believed to be high. Since confidence in the hydration dates from the Cerro del Medio source is low, these samples were excluded from the evaluative process along with one Polvadera date, a burned point from LA 51703-12 which yielded an

Table 8.7 Time Spans of Cross-Dated Points, Abiquiu Archaeological Study, ACOE, 1989.[1]

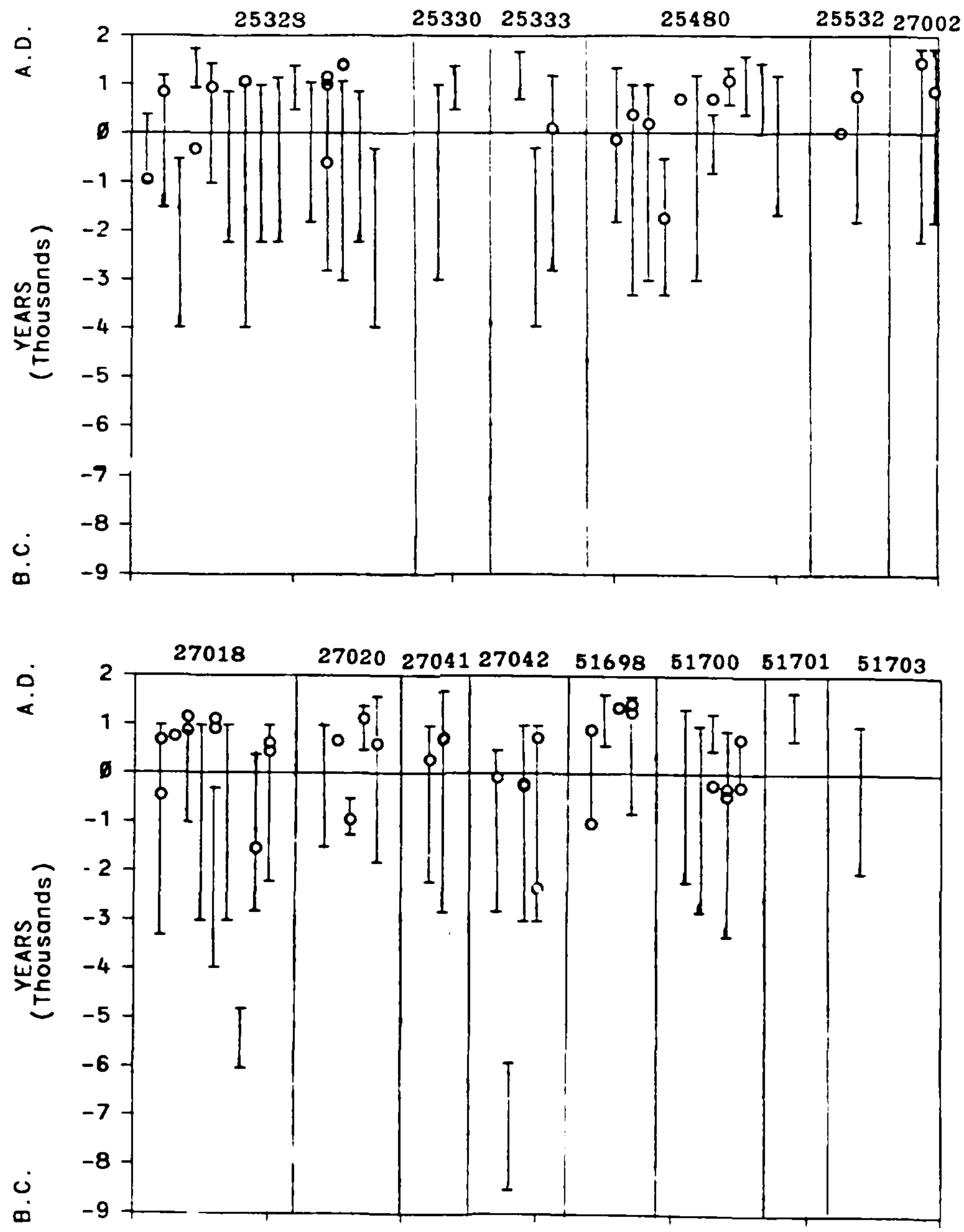
Specimen (Site.Artif. No.)	Cross-Dates Early	Cross-Dates Late	Obsidian Hydration Dates OH 1	OH 2	OH 3	OH 4
25328.06	-1000	400	-932	--	--	--
25328.07	-1500	1200	860	--	--	--
25328.17	-3950	-500	--	--	--	--
25328.19	950	1750	-292	--	--	--
25328.21	-1000	1450	964	--	--	--
25328.22	-2216	865	--	--	--	--
25328.23	-3950	1000	1083	1038	--	--
25328.25	-2216	1000	--	--	--	--
25328.26	-2216	1150	--	--	--	--
25328.27	500	1400	--	--	--	--
25328.34	-1800	1050	--	--	--	--
25328.42	-2800	1000	-586	1171	1012	1177
25328.43	-3000	1075	1411	1437	--	--
25328.44	-2216	865	--	--	--	--
25328.49	-3950	-300	--	--	--	--
25330.06	-3000	1000	--	--	--	--
25330.12	500	1400	--	--	--	--
25333.05	700	1700	--	--	--	--
25333.07	-3950	-300	--	--	--	--
25333.08	-2800	1200	106	--	--	--
25480.03	-1800	1350	-113	--	--	--
25480.04	-3300	1000	398	--	--	--
25480.06	-3000	1000	206	--	--	--
25480.09	-3300	-500	-1719	--	--	--
25480.13	--	--	720	712	--	--
25480.18	-3000	1200	--	--	--	--
25480.21	-800	400	712	--	--	--
25480.23	600	1350	1090	--	--	--
25480.25	400	1600	--	--	--	--
25480.27	1	1450	--	--	--	--
25480.29	-1650	1200	--	--	--	--
25532.02	--	--	31	--	--	--
25532.10	-1800	1350	780	--	--	--
27002.02	-2200	1750	1483	--	--	--
27002.05	-1800	1750	888	--	--	--
27018.02	-3300	1000	705	-437	--	--
27018.03	--	--	780	780	--	--
27018.06	-1000	865	902	1171	--	--
27018.09	-3000	1000	--	--	--	--
27018.12	-3950	-300	1134	937	--	--
27018.15	-3000	1000	--	--	--	--
27018.16	-6000	-4800	--	--	--	--
27018.26	-2800	400	-1523	--	--	--

Table 8.7 (Continued).

Specimen (Site.Artif. No.)	Cross-Dates Early	Late	Obsidian Hydration Dates OH 1	OH 2	OH 3	OH 4
27018.28	-2200	1000	474	643	--	--
27020.04	-1500	1000	--	--	--	--
27020.11	--	--	689	--	--	--
27020.12	-1250	-500	-932	--	--	--
27020.13	500	1400	1152	--	--	--
27020.14	-1800	1600	627	--	--	--
27041.01	-2200	1000	312	--	--	--
27041.02	-2800	1700	712	757	--	--
27042.02	-2800	500	-64	--	--	--
27042.03	-8500	-5900	--	--	--	--
27042.06	-3000	1000	-202	-232	--	--
27042.10	-3000	1000	-2321	750	--	--
51698.01	--	--	-1001	930	--	--
51698.02	600	1650	--	--	--	--
51698.05	--	--	1380	--	--	--
51698.07	-800	1600	1461	1288	--	--
51700.02	-2200	1350	--	--	--	--
51700.03	-2800	1000	--	--	--	--
51700.06	500	1250	-212	--	--	--
51700.09	-3300	900	-282	-426	--	--
51700.10	--	--	-242	737	--	--
51701.01	700	1700	--	--	--	--
51703.12	-2000	1000	-16815	--	--	--

1 -1000 = 1,000 B.C., +1000 = A.D. 1000.

Figure 8.9 Time Spans of Cross-Dated Points, Abiquiu Archaeological Study, ACOE, 1989.



KEY

° Obsidian hydration dates
Range of cross-date estimate

erroneous date of 16,815 ± 205 B.C. (86-831). The remaining dates range from 2,321 ± 70 B.C. (86-875) to A.D. 1483 ± 5 (86-827).

The evaluative method entails tabulating the number of correct estimates for a cross-dating scheme and determining the percentage of correct responses for the 26 hydration-dated specimens from Polvadera and Obsidian Ridge sources. A correct score was recorded each time a hydration date fell within the suggested cross-dated range estimate for that point type. In those instances where two hydration dates were obtained for a single specimen, a half correct score was recorded if only one date was within the cross-dated range. The concurrence of correct cross-dated age estimates and the obsidian hydration dates for each scheme is as follows: Irwin-Williams' (1973) Oshara sequence -- 8 of 16 (50 percent); Thoms' (1977) northern Rio Grande sequence -- 13 of 22 (59 percent); Lord and Cella's (1986) Abiquiu Reservoir sequence -- 15.5 of 22 (70 percent); and Anderson's (1985) western Plains sequence -- 15 of 18 (83 percent) correct. Despite its development for a separate region, the relative success of Anderson's sequence probably reflects the large sample size, greater attention to morphological refinements in the point typology, and much greater attention to compiling and evaluating associated dates from points over a wider region. Although the concurrence for individual schemes is low (especially for those specifically designed for northwestern New Mexico), only two of 26 specimens yielded obsidian hydration dates beyond the age estimate ranges of all schemes. These data support other preliminary studies (Lord and Cella 1986, Bertram 1987) which caution against relying too much on only the Osharan point morphology for determining strict temporal and cultural affiliations. The results of this comparison support Bertram's observations:

1) that the age estimates of the Oshara Tradition phases do not apply to the Abiquiu region;

2) that the age estimates of the Oshara Tradition phases are not valid;

3) that the projectile point styles assigned to the Oshara Tradition have a much longer period of usage than originally defined;

4) that the obsidian hydration rates for Polvadera Peak and Obsidian Ridge sources are not accurate;

5) that the hydration rates and the age estimates are both in error.

Possibility 5) is believed to be remote.

8.3.4 Abiquiu Reservoir Point Forms and the Oshara Tradition

Based on earlier estimates of Polvadera Peak, Cerro del Medio, and Obsidian Ridge obsidian hydration rates and a large sample of hydration dates from the present sample combined with an earlier Abiquiu Reservoir study conducted by CCP, Bertram (1987:5-64-5-65) postulated a series of morphological trends for north central New Mexico which question the validity of the Osharan sequence. Refinements in the obsidian hydration rates made since Bertram wrote Section 7 of this report and conducted his 1987 CCP study

and MAI's recalculations of some dates may alter some of the trends. This section examines Bertram's trends from the perspective of present data from the 18 tested Abiquiu sites. The trends delineated by Bertram (1987:5-64-5-65) include:

1) Starting about 200 B.C., corner-notched points evolve from an initial technology based on small and large points into a technology based on arrow points (haft width less then 10 mm), medium dart points (haft width between 10 and 16 mm), and very large points (haft width greater than 16 mm);

2) All three evolved types persist well into the Developmental Period (A.D. 600 to 1200);

3) Side-notched points experience a strong trend towards gradual linear reduction through time, such that, by around A.D. 900, most side-notched points are of arrow point size. Earlier side-notched points approach the large corner-notched point size range. A break in this gradual linear trend may be present ca. 300 B.C.

4) Stemmed projectile points and "Osharan" projectile points appear to exhibit great stability through time in both size and form; their distributions are not clearly distinguishable by size or temporally by style or subtype. Both stem types persist into the Developmental Period (ca. A.D. 600-1200); some "San Jose" or "Armijo" points may actually date to the Middle Coalition Period (ca. A.D. 1200-1325; Bertram 1987).

Several methodological problems underlie Bertram's study. First, the point classification is crude; the main distinctions consist of side- versus corner-notched forms subdivided into three size categories based only on haft width size. Like the Oshara sequence, such a typology lumps a wide range of point forms. The subdivisions based on haft width are arbitrarily defined and the divisions imposed on a continuous data set. No attempt has been made to utilize other metric variables or point attributes in the classification to ensure that the size units are meaningful or consistent with more conventional types. In addition, the chronological trends are delineated from a series of regression analyses in which haft width is plotted against time (B.P.) based on obsidian hydration dates and their standard error intervals; reliability weighting is included in the regression analysis according to the context and physical condition of the specimen and the known location of the obsidian hydration dated loci on the specimen. In general, the regression results for corner-notched dart and arrow points reflect statistical trends with relatively wide dispersions as reflected by low r (correlation) value calculations. Unweighted and weighted r values for dart points are -0.183 and -0.290, respectively, whereas the values for arrow points are . = unreported and +0.292 for unweighted and weighted dispersals around the regression. The Student's 2-tailed T-test is then inappropriately used on the weighted slope coefficients (ignoring the wide dispersion around the slope) to claim significance difference at greater than the 0.05 level. The temporal trends for points (e.g., the development of corner-notched arrow points starting about 200 B.C.) are determined by using the regression slope intersection for dif

ferent sized point haft widths (e.g., 10 mm) and obtaining the corresponding age values (e.g., 200 B.C.).

The use of haft widths in conjunction with a crudely developed typology probably has resulted in misleading trends. In the present sample, a side-notched point made from Obsidian Ridge source material with an "arrow point" haft width of less than 10 mm (artifact 9 from LA 25480) yielded a date of 1,719 ± 69 B.C. (86-836), but the overall morphology of the specimen (Figure 8.2E) is well within the shape range of shallow side-notched dart points with concave bases (San Jose/Armijo), not arrow points. The obsidian hydration date on this specimen is consistent with suggested age estimates based on all the cross-dated estimates. This example suggests that haft width alone is a poor typological indicator. Greater emphasis must be placed on the overall morphology of points.

Problems probably also exist in the use of the regression slope to determine dates for point trends. The suggestion that corner-notched arrow points started to "evolve" from dart points by about 200 B.C. (as determined from using the regression slope formula) fails to understand that the physics of the bow/arrow is distinct from that of the atlatl/dart; the technology of one did not evolve from the other, and quite likely neither did the points, since the weight and perhaps hafting constraints are quite different. The beginning age suggestion of 200 B.C. is linked to the arbitrarily defined haft width categories and also suffers from a lack of empirical reality. This date is about half a millenium earlier than the age of "arrow points" found in firmly dated contexts to the east (cf. Anderson [1985] for review of point ages).

These major problems not withstanding, the obsidian hydration dates derived from the present point forms suggest the following trends, if the dates are assumed to be reasonable:

1) The age of arrow point introduction in north central New Mexico is uncertain; the few obsidian hydration dates suggest that corner-notched forms were regionally in use by A.D. 712 (86-829; Figures 8.4K and 8.4H). Their occurrence in the region may be much earlier.

2) Large corner-notched, shoulder barbed dart points comparable to the En Medio forms (Figures 8.1F, 8.1I, 8.4C, 8.4E, and 8.4F) persist alongside the small arrow points into the late Developmental/early Coalition Periods (ca. A.D. 1000-1200). The co-occurrence of these point forms probably reflects the continued use of altatls alongside bows.

3) The present sample, with its high frequency of stem fragments, does not clarify the age when small side-notched arrow points occur. In general, the large side-notched points reflect considerable variability and range from large points with broad, shallow side notches placed close to the base to large points with deep notches placed well up the side. This variation may reflect either continuous or punctuated periods of usage. The large deeply notched flange forms occur by 2,321 ± 7 B.C. (86-875; Figure 8.3N) to ca. 202 ± 30 B.C. (86-871; Figure 8.3L).

4) Bertram's (1987) observation regarding the stemmed projectile points and "Osharan" projectile points appearing to exhibit great stability through time in both size and form is partially confirmed. The present sample does not provide support that San Jose forms presist into the Middle Coalition, but some "Armijo/En Medio" point forms continue to be made into the Developmental Period (cf. Figures 8.4K, 8.3E, and 8.3G).

The present results indicate that cross-dating based strictly on the Oshara Tradition provides problematic results. Increased emphasis on describing base morphology coupled with continued obsidian hydration studies on points promises to a provide firm basis for developing local chronologies in north central New Mexico.

8.4 CERAMICS

Site proveniences producing ceramics are discussed in this section, as well as associated dates for the types. A more detailed discussion and type references are presented in Chapter 11.

There were two sites containing ceramics in the Llano Piedra Lumbre site cluster. LA 25333 produced 274 Powhoge Polychrome sherds, the majority from a concentration located just west of the site datum. This type is known from the southern Tewa district. Associated dates are A.D. 1760-1850. LA 51698 contained one Penasco Micaceous sherd in two pieces. This sherd was found in a test unit in the Piedra Lumbre structure. Type dates are A.D. 1600-1900.

Two sites in Comanche Canyon contained ceramics. LA 25480 produced 15 Penasco Micaceous sherds. These were from the test unit at N419/E330 and from a 7-m^2 area in the northwest corner of surface collection Unit 1. This type dates from A.D. 1600-1900. LA 27020 produced 60 Valdito Micaceous and three Tewa Polished sherds, plus one Wiyo Black-on-white sherd. Valdito Micaceous is nearly identical to the unslipped plain culinary wares except for the mica slip. The Valdito sherds were from an 80-m^2 area south and southeast of the Piedra Lumbre structure (39 sherds), the N107/E108 test unit (18 sherds), and the N110/E108 test unit (three sherds). Additional ceramics were from the N111.5/E109 test unit. The Valdito Micaceous and Tewa Polished sherds date from A.D. 1600-1900. The Wiyo type dates to the A.D. 1275-1300 period; this type has carbon painted designs primarily on bowls and contains tuff temper.

Four sites containing ceramics were located in Arroyo de Comales. LA 25532 produced 20 Valdito Micaceous sherds, all from surface collection Unit 1. LA 51700 contained a concentration of ceramics in the northwestern corner of Unit 1; the N316/E293 test unit also produced ceramics. This site produced one Pueblo corrugated utility ware, dating from A.D. 900-1500, and one unidentified black-on-white, probably Santa Fe Black-on-white, which would date to the A.D. 1225-1350 period. Also present were 20 Chacon Micaceous sherds, dated in this study (Chapter 11) to the 1830s-1870s. LA 51701 contained one Gallina Black-on-white, dating to the mid-A.D. 1400s. Finally, LA 51703 produced 73 Chacon Micaceous sherds from Unit 1 and the N119/E99 test unit; this type is dated to the A.D. 1830s-1870s.

Ceramic occupation dates can be assigned to the following periods. LA 25333 and LA 51698, both on the Llano Piedra Lumbre, date to the Piedra Lumbre Phase (LA 51698) and to the post-Piedra Lumbre Phase historic occupation (LA 25333). The Piedra Lumbre Phase date for ceramics on LA 51698 agrees with the presence of a Piedra Lumbre structure nearby. Both ceramic types support a Tewa occupation of these sites.

Both LA 25480 and LA 27020 are dated by ceramic types to the Piedra Lumbre Phase and historic occupations postdating the phase. For LA 25480, this assignment is based on sherds from one type, Penasco Micaceous, while for LA 27020 the assignment to this period is based on Valdito Micaceous and Tewa Polished sherds, with one Wiyo sherd representing a Coalition Period use of the site. These ceramic types reflect a probable Tewa occupation of these sites.

The Arroyo de Comales sites with ceramics reflect considerably more variety in types. Of the six sites in this site cluster, only two (LA 51704, with no artifacts, and LA 51702) did not contain ceramics. LA 25532 contained Valdito Micaceous, indicating Tewa occupation during the Piedra Lumbre Phase or later. Two sites showed evidence of earlier Pueblo occupation: LA 51701, with one Gallina Black-on-white sherd dating to the mid-A.D. 1400s, and LA 51700, with one corrugated plainware sherd, dating to the Late Developmental-Coalition-Early Classic Period, and one unidentified black-on-white sherd (probably Santa Fe Black-on-white, dating to the Coalition Period). The other significant type is Chacon Micaceous, dated by historical documents to the A.D. 1830s-1870s, and occurring on LA 51703 and LA 51700. The Arroyo de Comales sites show Tewa Pueblo and earlier Pueblo occupations, as well as occupation by a Jicarilla Apache group.

8.5 CHRONOLOGICAL COMPARISONS FOR SITES WITH MULTIPLE KINDS OF DATES

This section compares site provenience dates derived from obsidian hydration and C-14 dating methods with dates of temporally diagnostic artifacts such as points and ceramics. Pre-San Jose Phase obsidian is not included in the following analysis which is aimed at discussing broad chronological patterns. Comparisons are made only for those sites with more than one type of date. Date reliability is assessed where possible.

8.5.1 LA 25328

LA 25328, in the Llano Piedra Lumbre site cluster, is represented by two kinds of dates, 57 obsidian hydration rinds and 13 cross-dated points. The obsidian dates (Table 8.8) show most evidence of occupation in the En Medio Phase, followed closely by the Early Developmental Period. Between one and three obsidian dates for each time period were obtained for the San Jose and Armijo Phases and Late Developmental and Coalition Periods. Twelve of 13 point time spans include the En Medio Phase. Eight points are dated beginning in the San Jose Phase, and 11 begin in the Armijo Phase. Nine points are cross-dated to include the Early Developmental Period. Seven of 13 end during the Late Developmental Period, indicating most intense occupation approximately between 3,000 B.C. and A.D. 1200. The cross-dates suggest as many as

Table 8.8 Frequency of Polvadera Peak and Obsidian Ridge Dates by Period for Sites with Obsidian, Abiquiu Archaeological Study, ACOE, 1989.

Site Cluster and Period/Phase	LA Numbers					Total	Percent
Llano Piedra Lumbre	25328	25330	25333	51698			
Historic	--	--	--	--		--	--
Classic	--	--	--	1		1	1
Coalition	2	1	--	2		5	6
Late Dev.	2	3	--	--		5	6
Early Dev.	21	1	--	2		24	30
En Medio	28	7	4	--		39	49
Armijo	3	1	--	--		4	5
San Jose	1	--	--	--		1	1
Total	57	13	4	5		79	98
Comanche Canyon	25480	27018	27020	27041	27042		
Historic	--	--	--	--	--	--	--
Classic	2	--	--	2	--	4	3
Coalition	1	--	--	1	2	4	3
Late Dev.	6	3	1	5	1	16	12
Early Dev.	12	14	3	7	10	46	34
En Medio	14	11	2	11	19	57	42
Armijo	2	2	1	1	--	6	4
San Jose	--	1	--	--	1	2	1
Pre Paleo	1	--	--	--	1	2	1
Total	38	31	7	27	34	137	100
Arroyo del Chamiso	27002	27004					
Historic	--	--				--	--
Classic	--	--				--	--
Coalition	--	--				--	--
Late Dev.	--	--				--	--
Early Dev.	3	--				3	38
En Medio	5	--				5	63
Armijo	--	--				--	--
San Jose	--	--				--	--
Total	8	--				8	101

Table 8.8 (Continued).

Site Cluster and Period/Phase	LA Numbers					Total	Percent
Arroyo de Comales	25532	51700	51701	51702	51703		
Historic	1	--	--	--	--	1	2
Classic	4	1	--	--	--	5	11
Coalition	1	--	--	--	--	1	2
Late Dev.	9	1	--	1	1	12	26
Early Dev.	7	9	--	--	--	16	34
En Medio	4	7	--	--	--	11	23
Armijo	--	--	--	--	--	--	--
San Jose	--	--	--	--	--	--	--
Pre Paleo	--	--	--	--	1	1	--
Total	26	18	--	1	2	47	98

four points could reflect occupation beginning during the Bajada Phase. However, since most points span at least three periods or phases, the more narrowly dated points are the most informative for comparative purposes. Thoms' type 19 point is dated to the Armijo and En Medio Phases, and Anderson's (1985) P71, P80 point is dated to the Late Developmental through Early Historic Period. The P71, P80 point is the only point postdating the Late Archaic sequence entirely.

Taken together, the obsidian and point dates agree on an intensive En Medio occupation on LA 25328. The Early Developmental Period indicated by obsidian hydration does not appear significant in the point data. The points suggest more Late Archaic use than the obsidian would suggest. The results suggest a later Late Archaic and an early Anasazi occupation at this site.

8.5.2 LA 25330

LA 25330, the second site in the Llano Piedra Lumbre cluster, is dated by 13 obsidian hydration and two point specimens. Once again, the En Medio Phase is well represented (seven obsidian cuts), followed by the Late Developmental Period (three cuts), with three phases or periods (Armijo, Early Developmental, and Coalition) represented by one cut each. The two points, not classified in the Oshara Tradition, overlap during the Early Developmental Period, although occupation could have occurred as early as the San Jose Phase and as late as the early Classic Period. Together, the results suggest En Medio Phase and Developmental Period occupations were the most intensive at this site.

8.5.3 LA 25333

LA 25333, located in the Llano Piedra Lumbre site cluster, is dated by four obsidian cuts, three points, and 274 sherds of a single ceramic type. The four obsidian dates all fall into the En Medio Phase. The time spans of two of the points overlap during the Early Developmental Period; the time spans of two others overlap during the San Jose, Armijo, and En Medio Phases. The Powhoge Polychrome sherds are dated from A.D. 1760-1850. Intensive occupation at this site occurred during the En Medio Phase and Early Developmental Period, with some use during the Historic Period.

8.5.4 LA 51698

LA 51698 is the final site in the Llano Piedra Lumbre site cluster. This site is dated by six C-14 samples, five obsidian rinds, two cross-dated points (two others are not cross-dated), one gun flint, and one sherd. The C-14 dates indicate occupation during the San Jose and Armijo Phases; the Early and Late Developmental, Coalition, and Classic Periods; as well as the Piedra Lumbre Phase or later Historic Period.

The Piedra Lumbre structure was dated by three samples, two of which fell within the Piedra Lumbre Phase dates of A.D. 1630-1740 (although the radiocarbon curve is complex at this point and tree-ring calibration date ranges include nineteenth and twentieth century dates). The Valdito Micaceous sherds found in one test unit inside the structure date between A.D. 1600 and 1900.

The independent dates on the structure type and the ceramic type suggest that the structure and associated features date to the Piedra Lumbre Phase, even though one of two dates from the same level of a pit outside of the structure falls within the Developmental Period; the early date may reflect the presence of old wood. The basin-shaped hearth, Feature 2, northeast of the Piedra Lumbre structure, was dated to a time spanning the Late Developmental, Coalition, and early Classic Periods. Three Penasco Micaceous sherds were recovered from the feature; these date to A.D. 1600-1900 and do not agree well with the C-14 date. The discrepancy could conceivably relate to old wood having been used in the hearth; old juniper snags are at present a common constituent of the Rio Chama slopes. An alternative interpretation is that both dates are correct and the sherds were deposited into an old hearth.

The third provenience for C-14 dates is an eroded hearth or hearth dump dated to the San Jose and Armijo Phases. Two of the obsidian rinds date to the Early Developmental and two to the Coalition Period; a fifth dates to the Classic Period. The two cross-dated points fall within the En Medio Phase through Classic Period span. The gun flint from Unit 4 probably dates to the A.D. 1650-1880 period, being perhaps associated with the Piedra Lumbre or later Historic Period occupation. There is no obsidian evidence for the C-14 dated San Jose/Armijo Phase occupation, but there is obsidian, radiocarbon, and point type support for Early Developmental, Coalition, and Classic Period occupation at this site. The congruence of dates from various sources indicates a certain measure of confidence in the obsidian hydration rate and consequent dates. This site is unusual for Llano Piedra Lumbre sites in having evidence for post-Developmental occupations. The Historic Period is represented at this site by two C-14 dates and a cross-date for one ceramic type, as well as Piedra Lumbre Phase dates for the Piedra Lumbre structure.

8.5.5 LA 25480

LA 25480 in Comanche Canyon is dated by 38 obsidian rinds, 10 cross-dated points, and 15 sherds of one ceramic type. The obsidian dates are predominantly later Late Archaic and Early Pueblo. There are 14 En Medio Phase, 12 Early Developmental Period, and six Late Developmental Period obsidian dates. There are one or two each Armijo Phase and Coalition and Classic Period obsidian dates. The 10 points overlap to the greatest degree during the En Medio Phase (eight points), Developmental Period (seven points), and Armijo Phase (six points). Four points are cross-dated to the Coalition Period. The sherds are Penasco Micaceous, dated to the A.D. 1600-1900 period. As with LA 51698 and LA 25333, the sherds point to a later Historic Period use that may (as with the Piedra Lumbre structure and C-14 dates on LA 51698) or may not (as with LA 25333) be corroborated by dates on other materials.

8.5.6 LA 27018

LA 27018 in Comanche Canyon is dated by 31 obsidian rinds and eight cross-dated points. The obsidian dates number 14 for the Early Developmental Period and 11 for the preceding En Medio Phase. Periods or phases with one to three dates are the San Jose Phase (one date), the Armijo Phase (two dates), and the Late Developmental Period (three dates). The overlap in point time spans indicates most intensive occupation at this site during the Armijo and

En Medio Phases (seven points each), followed closely by the San Jose Phase (six points) and Early Developmental Period (five points). The cross-dated point evidence also indicates Late Developmental Period, Bajada Phase, and Jay Phase occupations. The En Medio Phase and Early Developmental Period occupations are corroborated by the obsidian evidence. The obsidian data are more ambiguous on the San Jose and Armijo Phase occupations indicated by the points; obsidian points cross-dated to long time spans beginning during these phases may be erroneously dated too early, based on obsidian evidence presented in section 8.3.

8.5.7 LA 27020

LA 27020 in Comanche Canyon is dated by seven obsidian rinds, four cross-dated points, three C-14 samples, and three ceramic types in varying quantities. The obsidian dates range from the Armijo Phase to the Late Developmental Period, with three Early Developmental Period, two En Medio Phase, and one each Armijo Phase and Late Developmental Period dates. The points range from the Armijo Phase to the Classic Period. Three points show evidence of Armijo and En Medio Phase occupation and Early and Late Developmental Period occupation, while two points indicate Coalition and Classic Period occupation also. The C-14 dates are all from the Piedra Lumbre structure and all date to the late Classic Period, Piedra Lumbre Phase, or Historic Period. The two dates from near the center of the structure and the ash/charcoal area south of the structure are very similar, dating to the early Piedra Lumbre Phase (A.D. 1630-1680) and only slightly overlap with the date from the southwest interior corner of the structure, which shows occupation during the latter part of the Piedra Lumbre Phase. Ceramic types are Valdito Micaceous, dating from A.D. 1600-1900; Tewa Polished, dating to the same period; and one Wiyo Black-on-white, dating to the Coalition Period.

When these four dating sources are taken into account, the following patterns hold. The obsidian and point cross-dates are quite similar, showing Armijo Phase to Late Developmental Period occupation, with the exception that the points indicate the additional presence of Coalition and Classic Period occupation. The Coalition and Classic Period occupations are confirmed by ceramics and C-14 samples. The C-14 and ceramic type dates are also in congruence in showing a significant Piedra Lumbre Phase/Early Historic Period occupation at this site.

8.5.8 LA 27041

The fourth site in Comanche Canyon, LA 27041, is dated by 27 obsidian rinds and two point types. The obsidian dates indicate intensive occupation during the En Medio Phase (11 dates), and Early (seven dates) and Late (five dates) Developmental Periods. There are one or two dates each during the Armijo Phase, and Coalition and Classic Periods. The two points overlap during the San Jose Phase through Late Developmental Periods, with one point extending into the Classic Period. The obsidian dates suggest that these point type time spans are dated beginning too early, but support a continuation of occupation into the Classic Period at this site.

8.5.9 LA 27042

The final site in Comanche Canyon, LA 27042, is dated by 34 obsidian cuts and five point types. The obsidian dates are predominantly En Medio Phase (19 dates) and Early Developmental Period (10 dates). Other periods represented by one or two dates are San Jose Phase and Late Developmental and Coalition Periods (plus one specimen, probably not cultural, predating the PaleoIndian Period). The point types include one PaleoIndian point, plus point types dated from the San Jose Phase to the Classic Period. Four of five points are dated to include the San Jose through En Medio Phases, and three include the Early and Late Developmental Periods as well. One point is dated as extending into the Classic Period. Taken together, the two dating sources suggest intensive occupation during the En Medio Phase and Early Developmental Period, with more ephemeral occupations beginning in the San Jose Phase and apparently ending in the Coalition Period.

8.5.10 LA 27002

LA 27002, one of two sites in the Arroyo del Chamiso cluster, is dated by eight obsidian rinds and two points. The obsidian dates indicate two periods of occupation, the En Medio Phase (five dates) and the succeeding Early Developmental Period (three dates). The two points, on the other hand, overlap from the Armijo Phase through the Classic Period. Both types of dates indicate occupation during the En Medio Phase and Early Developmental Period, so occupation of this site is most reliably assigned to this time span.

8.5.11 LA 27004

The second site in the Arroyo del Chamiso cluster, LA 27004, is not dated by obsidian, points, C-14, or ceramics.

8.5.12 LA 25532

The first site in the Arroyo de Comales cluster, LA 25532, is dated by 26 obsidian dates, one cross-dated point, and 20 Valdito Micaceous sherds. Obsidian dates are most numerous for the Late Developmental Period (nine dates), followed by the Early Developmental Period (seven dates), En Medio Phase (four dates), and Classic Period (four dates). Represented by one obsidian date each are the Coalition and Historic Periods. The point for this site spans the Armijo Phase through Coalition Period; the obsidian dates suggest that the occupation more likely occurred during the latter part of that time span. The ceramics date to the A.D. 1600-1900 period and confirm a late Classic or early Historic Period (Piedra Lumbre Phase?) date. This site features the only Historic Period obsidian date produced by this project; the congruence of obsidian dates with other date sources suggests that these dates are generally reliable for the time spans of periods used in this report. The occurrence of only one historically used obsidian specimen indicates either that the estimated hydration rate biased results against recent dates or that occupants of these sites during the Historic Period tended not to work obsidian.

8.5.13 LA 51700

LA 51700, the second site in the Arroyo de Comales site cluster, is dated by 18 obsidian rinds, four cross dated points, and three ceramic types. The obsidian specimens reflect intensive use of the site during the Early Developmental Period (nine dates) and preceding En Medio Phase (seven dates). The Late Developmental and Classic Periods are represented by one date each. The four points show the greatest overlap in time spans during the Early Developmental Period (four points), with three points showing overlap during the Armijo and En Medio Phases and Late Developmental Period. Two points each indicate occupation during the San Jose Phase and Coalition Period. The obsidian and point type dates together suggest intensive occupation during the En Medio Phase and Early Developmental Period. The ceramic types are a corrugated Pueblo utility ware dating to the A.D. 900-1400s, an unidentified whiteware (possibly Santa Fe Black-on-white dating to the Coalition Period), and Chacon Micaceous dating to the 1800s. The sherds support the presence of a Late Developmental, Coalition, and early Classic Period occupation indicated by obsidian and point types and suggest a Historic Period occupation as well.

8.5.14 LA 51701

The third site in the Arroyo de Comales site cluster, LA 51701, is dated by one cross-dated point and a black-on-white sherd. The point is dated to the Early Developmental through Classic Periods. The sherd is Gallina Black-on-white, a type dating to the early Classic Period. Together, the artifact types indicate a probable Classic Period occupation.

8.5.15 LA 51702

The fourth site in the Arroyo de Comales cluster, LA 51702, is dated by one obsidian date. This date falls within the Late Developmental Period and cannot be evaluated further.

8.5.16 LA 51703

The fifth and final site in this cluster (eliminating from consideration LA 51704, which contained no artifacts or features), LA 51703, is dated by one cultural obsidian date (ignoring the pre-PaleoIndian date), one point, and one ceramic type. The obsidian specimen dates to the Late Developmental Period. The point dates to the San Jose Phase through Late Developmental Period, perhaps confirming a Late Developmental occupation. The sherds are Chacon Micaceous and date to the 1800s.

8.5.17 LA 51699

This site in the Canada de Chama produced no obsidian, points, C-14 samples, or ceramics. Its date is uncertain.

8.6 SUMMARY

The chronological information suggests a number of patterns that are explored more fully in Chapter 12. Two of the more notable chronological

pattterns are mentioned here. First, the obsidian and point data indicate intensive En Medio Phase and Early and Late Developmental Period occupations at the project sites. Another pattern is for Historic Period occupation to be represented by architecture (Piedra Lumbre structures) and features with C-14 samples, as well as ceramics. Additional Historic Period occupations, perhaps ephemeral, are indicated by ceramic types, with no other dates for the Historic Period; this pattern obtains at four sites (LA 25333, LA 25480, LA 51700, and LA 51703).

9.0 INTERSITE ANALYSES

W. Nicholas Trierweiler and Amy C. Earls

9.1 COLLECTION UNIT ANALYSIS

This section discusses an analysis of the artifact assemblages from the individual collection units. In an attempt to bypass the sometimes meaningless archaeological definition of a "site", the assemblages from individual surface collection units were analyzed without regard for sites. Rather, characteristics of the smaller, more explicitly defined subsite areas were examined to assess variability within each site and across the landscape.

Surface collection units rather than proveniences were used because of data base constraints. The surface collection units may be assumed to represent distinct spatial clusters of artifacts. In general, the field methods targeted visually distinct and generally high density areas for collection. Whether or not these spatial clusters reflect single activities or even temporally related sets of activities cannot yet be determined. However, these units are more likely by their spatially restricted nature to reflect a limited set of activities than are the sites themselves, which vary considerably in size and artifact density.

9.1.1 Methods

The 17 sites having formal collection units (excluding LA 51704) contained a total of 39 surface units. These ranged in size from one unit of 25 m^2 to several units of 900 m^2 each; the number of lithics per collection unit ranged from a minimum of two to a maximum of 6,194. Of the 39 units, 36 had a sample of 25 or greater artifacts, and these were used in the following analyses. The lithic data bases for each of these 36 surface collection units were reduced to the seven following summary statistics.

1) Pedernal chert lithics as a percentage of all lithics.

2) Polvadera obsidian lithics as a percentage of all lithics.

3) Number of ground stone specimens.

4) Biface flakes as a percentage of all lithics.

5) Heat treated lithics (both successful and unsuccessful) as a percentage of all Pedernal chert lithics.

6) The mean percent of cortex for all lithics. This value was obtained by multiplying the number of specimens in each of the six ordinal cortex categories (0 percent, 1-25 percent, 26-50 percent, 51-75 percent, 76-99 percent, 100 percent) by the median percentage of the category (0 percent, 12.5 percent, 37.5 percent, 62.5 percent, 87.5 percent, 100 percent), summing these values, and then dividing the result by the total number of specimens in the collection unit.

7) Lithic tools, as a percentage of all lithics.

Two additional variables were recorded for each collection unit:

8) The mean density of artifacts in the collection unit, obtained by dividing the area of the collection unit in square meters by the total number of lithics in the unit.

9) The mean date of the unit. This summary value was obtained by averaging all available obsidian hydration dates (for Polvadera and Obsidian Ridge specimens only) using positive values for A.D. dates and negative values for B.C. dates. Units with no hydration dates were recorded as missing data. It must be emphasized that this value is intended as a measure of central tendency only, and should not be interpreted as an actual occupation date.

These data are presented in Table 9.1. The data were statistically analyzed using the SYSTAT program package for MS-DOS microcomputers. To identify primary sources of variability within the data base, the data were first reduced using a Pearsons product-moment coefficient correlation matrix. Second, a K-means (nonheirarchical) cluster analysis was performed on selected variables, using Euclidean distances, to identify meaningful clusters of units within multidimensional space. The K-means cluster maximizes between-cluster variation over within-cluster variation. The unconstrained search potential is informative of structure or patterning inherent in the data.

9.1.2 Results

Applying Pearsons "r", and using 34 degrees of freedom with a two-tailed test, several significant correlations were found among the nine variables at the 0.05 probability level.

Not surprisingly, Polvadera obsidian and Pedernal chert were very highly inversely linked (r=-.86). These values are alternate states (given the very low percentages of materials other than Pedernal and Polvadera) of a single variable (material) and are thus not independent. As a result, one of the attributes, arbitrarily Polvadera obsidian, was dropped from the cluster analysis.

More meaningfully, high percentages of heat treated chert were found to be associated with the presence of ground stone (r=+.36). Assuming that heated chert debitage and ground stone represent different kinds of activities (tool manufacture vs. food preparation), this pattern possibly reflects the preferential selection of certain areas for multiple uses or multiple occupations. The pattern could also reflect a greater incidence of heat treatment in Coalition through Historic Period assemblages (those with most frequent ground stone) similar to the results of CCP's (Lord and Cella 1986) study of well-dated assemblages, which showed that assemblages from a Tewa pueblo occupied during the Classic Period had a higher incidence of heat treated debitage than Late Archaic and Piedra Lumbre assemblages (Hicks 1986).

Table 9.1 Summary Statistics for 36 Lithic Assemblage Collection Units, Abiquiu Archaeological Study, ACOE, 1989.

Site-Unit	% Pedernal	% Polvadera	Ground Stone	% Biface Flakes	% Heat Treatment	Average % Cortex	% Tool	Density	Median Date
25328-1	0.17	0.80	0	0.03	0.39	0.07	0.06	2.6	--
25328-2	0.30	0.35	0	0.08	0.53	0.03	0.06	0.6	--
25328-3	0.84	0.14	0	0.05	0.47	0.05	0.03	5.9	--
25328-4	0.82	0.15	0	0.04	0.52	0.03	0.02	6.0	292
25328-5	0.79	0.12	0	0.06	0.69	0.01	0.02	12.9	-36
25330-1	0.81	0.15	2	0.05	0.52	0.04	0.05	1.8	--
25330-2	0.80	0.16	0	0.05	0.52	0.07	0.12	0.8	--
25333-1	0.51	0.16	2	0.05	1.00	0.02	0.06	0.1	106
25480-1	0.31	0.64	1	0.09	0.90	0.05	0.06	4.1	901
25480-2	0.45	0.31	2	0.17	0.87	0.02	0.02	4.6	256
25480-3	0.49	0.23	0	0.18	0.95	0.02	0.02	2.3	206
25480-4	0.52	0.34	1	0.10	0.63	0.01	0.05	0.7	716
25532-1	0.51	0.41	0	0.07	0.73	0.17	0.09	1.1	31
25532-2	0.55	0.41	4	0.05	0.86	0.09	0.08	3.4	780
27002-1	0.66	0.30	0	0.12	0.67	0.12	0.04	0.5	1483
27004-1	0.94	0.03	0	0.18	0.91	0.08	0.03	0.3	--
27018-1	0.69	0.18	0	0.12	0.67	0.03	0.05	3.9	340
27018-2	0.98	0.01	0	0.13	0.83	0.01	0.04	8.4	--
27020-1	0.66	0.30	0	0.09	0.73	0.09	0.03	0.4	384
27041-1	0.71	0.22	0	0.13	0.89	0.02	0.06	1.3	594
27042-1	0.94	0.03	0	0.22	0.89	0.07	0.07	1.1	-64
27042-2	0.01	0.90	0	0.07	1.00	0.02	0.04	1.7	--
27042-3	0.34	0.55	0	0.08	0.67	0.04	0.08	0.7	-217
27042-4	0.27	0.44	0	0.08	0.70	0.07	0.06	2.8	--
51698-1	0.38	0.25	0	0.26	0.85	0.09	0.07	0.2	--
51698-2	0.63	0.33	1	0.13	0.60	0.18	0.08	0.1	1375
51699-1	0.96	0.00	0	0.00	0.79	0.41	0.12	--	--
51700-1	0.87	0.09	0	0.10	0.67	0.04	0.05	1.1	--
51700-2	0.52	0.44	0	0.11	0.72	0.09	0.04	5.3	-212
51701-1	0.81	0.00	0	0.08	0.17	0.09	0.08	1.1	--
51701-2	0.86	0.10	1	0.01	0.53	0.15	0.10	0.6	--
51702-1	0.97	0.01	0	0.07	0.62	0.06	0.03	3.2	--
51702-2	0.99	0.01	0	0.04	0.69	0.07	0.03	5.5	--
51703-1	0.94	0.03	0	0.06	0.77	0.13	0.08	6.3	-16815
51703-2	0.92	0.04	0	0.05	0.85	0.11	0.04	3.5	--
51703-3	0.91	0.05	0	0.06	0.89	0.13	0.06	1.9	--

Importantly, and interestingly, the proportion of Pedernal chert was not significantly correlated with the incidence of heat treatment (r=.22). In other words, the proportion of chert which was heated was independent of the overall proportion of chert to other lithic materials.

The density of artifacts within a collection unit was inversely linked with the percentage of tools (r=-.42), indicating that tools are more likely to be found in association with sparse clusters of debitage. This association suggests that dense scatters reflect more manufacturing activities and less utilization activities than sparse areas of scatter.

Interestingly, date was inversely linked to the proportion of Pedernal chert (r=-.45), and positively with the proportion of Polvadera obsidian (r=+.40), suggesting a shift over time to greater use of obsidian. However, this pattern is likely a reflection of the fact that all of the dates are from Polvadera obsidian, and later dates are merely more frequent than earlier dates. There are several problems with the date variable. First, it is simply a central tendency of between one and eight readings, with no measure of range. Further, 18 of the units (50 percent) had missing data for "date" and were not included in the analysis. For these reasons, "date" was not used in the cluster analysis.

The mean percent of cortex on all lithics and the overall percent of tools were highly correlated (r=+.56). Although this may be initially surprising since tools generally have little cortex, the pattern actually suggested that tools are expectedly found in association with high cortex artifacts, such as cores and core flakes.

These results suggested that the nine variables are not completely independent and that a cluster analysis of all nine would be biased towards the nonindependent variables. Consequently, it was decided to include only four of the most independent, reliable, and meaningful of the nine variables. These were percent Pedernal chert, percent biface flakes, average percent cortex, and percent heat treated (of Pedernal chert).

Using these four variables, the K-means cluster analysis identified four distinct clusters of collection units. These clusters were defined largely on the interaction between the Pedernal chert and heat treatment variables. In fact, the variability existing within the biface flake and cortex variables was largely obscured by the Pedernal and heat treatment variables.

As a result, all collection units may be classified as having either a "high" or a "low" percentage of Pedernal chert, crosscut by "high" and "low" percentages of heat treatment. Most of the units have high percentages of both Pedernal chert and heat treatment. Of the 36 units, 21 (58 percent) are in this cluster. By contrast, only one unit (three percent) is in the high Pedernal, low heat treated cluster. The four clusters are summarized in Table 9.2, and Appendix I presents the uninterpreted results of the K-means cluster analysis.

Obviously, the majority of the unit assemblages are grouped in cluster 1, defined by high Pedernal and high heat treatment, and the bulk of the remain-

ing units are in cluster 2, defined by low Pedernal but with high heat treatment. However, the distribution of units among the four clusters produces some interesting observations.

Table 9.2 Collection Unit Clusters, Abiquiu Archaeological Study, ACOE, 1989.

	High Percent Pedernal	Low Percent Pedernal
High Pct. Heat	CLUSTER 1 LA 25328, Unit 3 LA 25328, Unit 4 LA 25328, Unit 5 LA 25330, Unit 1 LA 25330, Unit 2 LA 27002, Unit 1 LA 27004, Unit 1 LA 27018, Unit 1 LA 27018, Unit 2 LA 27020, Unit 1 LA 27041, Unit 1 LA 27042, Unit 1 LA 51698, Unit 2 LA 51699, Unit 1 LA 51700, Unit 1 LA 51701, Unit 2 LA 51702, Unit 1 LA 51702, Unit 2 LA 51703, Unit 1 LA 51703, Unit 2 LA 51703, Unit 3	CLUSTER 2 LA 25333, Unit 1 LA 25480, Unit 1 LA 25480, Unit 2 LA 25480, Unit 3 LA 25480, Unit 4 LA 25532, Unit 1 LA 25532, Unit 2 LA 27042, Unit 2 LA 27042, Unit 3 LA 27042, Unit 4 LA 51698, Unit 1 LA 51700, Unit 2
Low Pct. Heat	CLUSTER 3 LA 51701, Unit 1	CLUSTER 4 LA 25328, Unit 1 LA 25328, Unit 2

Of the five collection units on LA 25328, three units (3, 4, 5) are in the high Pedernal. high heat cluster, while the other two units (1, 2) are in the low Pedernal, low heat cluster, and in fact entirely define that cluster. The technological attributes of the artifact assemblages from these clusters are significantly different, and the units represent entirely different activities. Unfortunately, dates are not available for either Unit 1 or Unit 2, and so the distinctions cannot be compared temporally.

By contrast, the four collection units from LA 25480 are all within the same low Pedernal, high heat cluster, and probably reflect similar activities.

The two collection units on site LA 51701 have high percentages of Pedernal chert but differ in the proportion of that chert which is heat treated. Unit 2 has a high proportion of heat treatment and is grouped with the majority of the units. By contrast, Unit 1 has a low proportion of heat treatment together with a high proportion of chert, making it unique among the 36 assemblages.

Three sites -- LA 27042, LA 51698, and LA 51700 -- have collection assemblages in both clusters 1 and 2.

Several lithic assemblage trends were identified by the Pearson's correlation on 36 collection units from 17 sites. First, the association of heat treatment with the presence of ground stone suggests that certain site areas were used both for lithic manufacture and food processing during a single occupation or many occupations. The association of these two variables might suggest that both kinds of materials are located near a hearth; however, there were only 10 total hearths identified on the surface and subsurface of the 18 sites investigated. Of the 36 units used in the cluster analysis, only seven contained hearths, so it is unlikely that the presence of hearths was the basis for an association between heat treated Pedernal chert and ground stone. It is possible that such hearths once existed and have been eroded completely, but there is little research potential in examining the matter further.

The lack of an association between Pedernal chert percentage and heat treatment reflects the high percentage of heat treatment in all but three of the units. The relationship between low artifact density and high tool percentage may simply indicate that tools occur in low frequencies and their numbers are overwhelmed by debitage frequencies in all but low density areas. By this thinking, tools would tend to be discarded at a relatively constant rate, with their percentage of the lithic assemblage varying according to the density of the more commonly discarded debitage. A less likely possibility is that the low artifact density and high tool relationship reflects a tendency for less lithic reduction and more tool use (or at least discard) in areas of sparse artifacts. The relationship between Polvadera percentage and age is considered spurious, reflecting the fact that most dates are from Polvadera obsidian. The correlation between high cortex and tool percentages, when taken in conjunction with the association between low artifact density and high tool percentage, indicates that tools were used or discarded with early reduction stage (high cortex) debris. These associations support a pattern of high debitage discard rates with a lower rate of tool discard.

The cluster analysis of lithic assemblage characteristics from 36 surface collection units suggested that important differences among assemblages were indicated by percentage of Pedernal chert and percentage of heat treatment. Heat treatment is a significantly present variable in most of these Abiquiu site assemblages. Ninety-two percent of the assemblages were characterized by high percentages of heat treatment.

Six sites were analytically distinct based on the cluster analysis results. LA 25328 had units with either high percentages of Pedernal chert and heat treatment or low percentages of Pedernal chert and heat treatment. All units on LA 25480 had low percentages of Pedernal chert and high percentages

of heat treatment. The homogeneity of this assemblage is somewhat surprising given the large site and assemblage size; as a result, this site was treated in the spatial analysis. Both LA 51701 units had high percentages of Pedernal chert, but one had a high percentage of heat treatment and the other low. LA 27042, LA 51698, and LA 51700 all had units in two clusters: both clusters with high percentages of heat treatment but varying in the percentages of Pedernal chert.

These distinct sites were from the Llano Piedra Lumbre, Comanche Canyon, and Arroyo de Comales site clusters. The two sites from the Llano Piedra Lumbre cluster (LA 25328 and LA 51698) had units with either high percentages of Pedernal chert and heat treatment or low percentages of Pedernal chert and varying percentages of heat treatment. There were no units with both high percentages of Pedernal chert and low percentages of heat treatment. The two sites from the Comanche Canyon cluster (LA 25480 and LA 27042) both had high percentages of heat treatment while Pedernal chert proportions varied among different units. The two sites from the Arroyo de Comales cluster (LA 51700 and LA 51701) tended to have high percentages of Pedernal chert and heat treatment; there were no units with both low Pedernal chert and low heat treatment percentages. Units from the Llano Piedra Lumbre and Arroyo de Comales clusters were equal in variability, with units from each geographic location occurring in three clusters. Both locations had units in the high heat treatment cluster, while additional Llano Piedra Lumbre units were in the low percentage Pedernal chert and heat treatment cluster and the additional Arroyo de Comales unit was in the high percentage Pedernal chert, low percentage heat treatment cluster. Six of 10 (60 percent) Llano units were in the high percent Pedernal chert category, and four units (40 percent) were in the low percent Pedernal chert category. On the other hand, eight of 11 (73 percent) Arroyo de Comales units were in the high percent Pedernal chert, and three units (27 percent) were in the low percent Pedernal category. Of the 12 Comanche Canyon units, five (42 percent) were in the high percent Pedernal chert and seven (58 percent) in the low Pedernal chert categories. All Arroyo del Chamiso and Canada de Chama units were in the high percent Pedernal chert category. Thus, there appear to be some differences in use of the landscape as represented by site cluster locations. Cluster locations with 50 percent or more units containing high percentages of Pedernal chert were Llano Piedra Lumbre, Arroyo de Comales, Arroyo del Chamiso, and Canada de Chama.

Comanche Canyon is different in having only 42 percent of its units containing high percentages of Pedernal chert. Use of this canyon, the deepest and best developed of the tributary arroyos studied, may have involved different procurement or travel patterns than the usage typically associated with the smaller tributaries and the main Rio Chama canyon. If lithic materials used at the Comanche Canyon sites were from local canyon cobbles, then the low percentage of Pedernal chert may indicate its rarity in the Comanche Canyon area. The high percentage of heat treatment identified in the present study may be related to the fact that all but one of the sites examined by MAI are on the northeastern lake shore where only tributary stream cobble sources are locally available. In contrast, the CCP study examined more sites on the southern lake shore and adjacent to the Rio Chama, where the primary sources of high quality terrace gravels occur (Whatley and Rancier 1986).

9.2 SPATIAL ANALYSIS

This section discusses the results of intrasite and intersite spatial analysis of artifact distributions on two sites, LA 27002 and LA 25480. The aim is to distinguish activity areas and general site formation processes. An attempt is made to distinguish single and multiple occupational events as well as postdepositional processes acting on cultural deposits. The objective is to isolate artifact assemblages or subassemblages with chronological, spatial, or technological integrity. The approach is to examine lithic assemblage trajectory (from core to finished tools) and temporal differences.

9.2.1 Site Selection

LA 27002 and LA 25480 were selected in order to compare lithic assemblage distribution differences between a small, isolated site (LA 27002) from Arroyo del Chamiso and a site (LA 25480) in the cluster of large, complex sites in Comanche Canyon. These two sites have differing artifact densities, varying from 0.5 artifact/m^2 on LA 27002's single unit to from 0.7 artifact/m^2 on Unit 4 to 4.6 artifacts/m^2 on Unit 2 of LA 25480. At the same time, the cluster analysis (section 9.1) showed that LA 25480 was unusual for large sites in having all four units in one Pedernal chert and heat treatment cluster.

LA 25480 is located north of the north fork of Comanche Canyon and measures 17,500 m^2. The site is 1,600 m northeast of the Chama River channel prior to reservoir inundation, and its relatively stable surface is covered with grass. LA 27002 is north of Arroyo del Chamiso and overlooks an unnamed drainage. The site is 250 m northeast of the old river channel, and deposits are located on sandstone bedrock overlain with gravels and thin sands. Most artifacts occur along the mesa slope down to the unnamed drainage. There is greater topographic relief on LA 25480 than on LA 27002. The north fork of Comanche Canyon (approximately 160 feet deep) is also considerably deeper than the unnamed drainage (approximately 60 feet deep) north of Arroyo del Chamiso.

Obsidian hydration dates and ceramic and point cross-dates suggest that LA 25480 experienced multiple occupations while the smaller site has dates reflecting only two periods of use, the En Medio Phase of the Late Archaic and the Early Developmental Period of the Anasazi occupation. The cluster analysis showed that all four LA 25480 units were in the high heat treatment and low Pedernal chert cluster. The LA 27002 unit was in the high heat treatment and high Pedernal chert cluster.

9.2.2 Methods

Methods used in the spatial analysis involved graphic representation of artifact distributions by selected artifact groups and comparison with locations of dated samples. Artifact groups were defined to include artifact types from various stages in the lithic reduction process and to include artifacts that could be grouped into relative size categories. Groups were all debitage (unknown, biface, and core flakes and small angular debris); biface flakes; core flakes; cores and large angular debris; and tools (including four pieces of ground stone on LA 25480). Artifacts in the debitage and two flake categories were generally smaller than those in the core and tool

categories; these size differences were examined and compared with site slope and depositional condition in order to assess the severity of postdepositional processes acting on these assemblages.

Artifact groups were sorted and plots produced using SYSTAT's plot routine on an IBM-compatible MS-DOS personal computer. Dates were grouped into Irwin-Williams' (1973) Archaic phase classification and Wendorf and Reed's (1960) Anasazi classification. For low density artifact or data class groups (e.g., cores and dates), actual grid locations are presented in the figures, while for high density artifact groups (e.g., debitage and flakes), contour maps were produced. The contour maps show three levels of artifact density, ranging from 1 to >4 items per grid square (this figure is not equivalent to artifact density per square meter since values are not averaged over empty grid squares). Locations without artifacts are also clearly represented.

9.2.3 Results

Results are presented in the following order. Patterning in terms of lithic reduction trajectory is discussed first with reference to dates, followed by a consideration of multicomponency and other possible postdepositional factors, and concluding with a comparison between the two sites. LA 27002, the smaller and less complex site, is discussed before LA 25480.

9.2.3.1 LA 27002

On LA 27002, Pedernal chert comprised 65 percent (299 pieces) of the total assemblage (451 pieces) on this site, while Polvadera obsidian, the only other significant material type, was 30 percent (136 items). All artifacts collected were from a single 30 x 30 m unit. Artifact distribution figures are presented and discussed in the following pages.

Figure 9.1 shows the broad pattern of artifact distribution of all debitage on this collection unit. There are a high density of materials in the north central portion of the collection unit and low density scatters at the south central and eastern portions of the collection unit. Examination of Figures 9.2 and 9.3 shows that two of the three cores occur in the dense north central area. The third core is in the west central portion of the unit, about halfway between the dense cluster and a low density cluster of core flakes in the southern part of the unit. Comparison of Figures 9.1 and 9.3 shows that both the dense north central concentration and the low density south central cluster are composed primarily of core flakes. In contrast, all biface flakes occur in a 15-m east-west by 8-m north-south area within the north central dense concentration (Figure 9.4). Tools also occur exclusively in the north central dense concentration (Figure 9.5).

The dates from this site, all from obsidian hydration, indicate En Medio Phase and Early Developmental Period occupation. All dates are from the north central concentration that contained core and biface flakes and tools (Figure 9.6). The En Medio dates are only slightly more clustered than the Early Developmental dates, indicating no particular spatial integrity.

Figure 9.1 LA 27002, Density Contour Plot of All Debitage, Abiquiu Archaeological Study, ACOE, 1989.

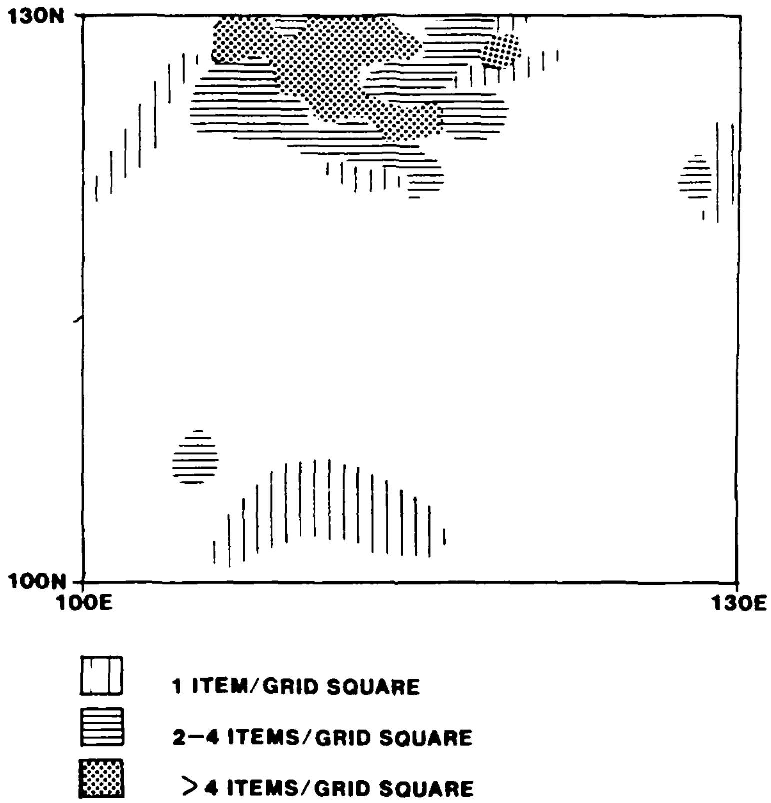


Figure 9.2 LA 27002, Plot of Cores, Abiquiu Archaeological Study, ACOE, 1989.

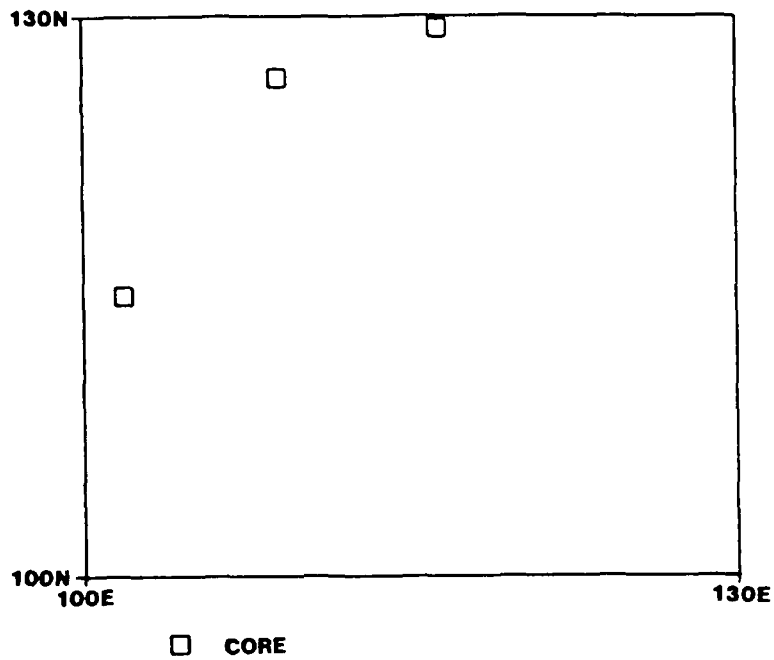


Figure 9.3 LA 27002, Density Contour Plot of Core Flakes, Abiquiu Archaeological Study, ACOE, 1989.

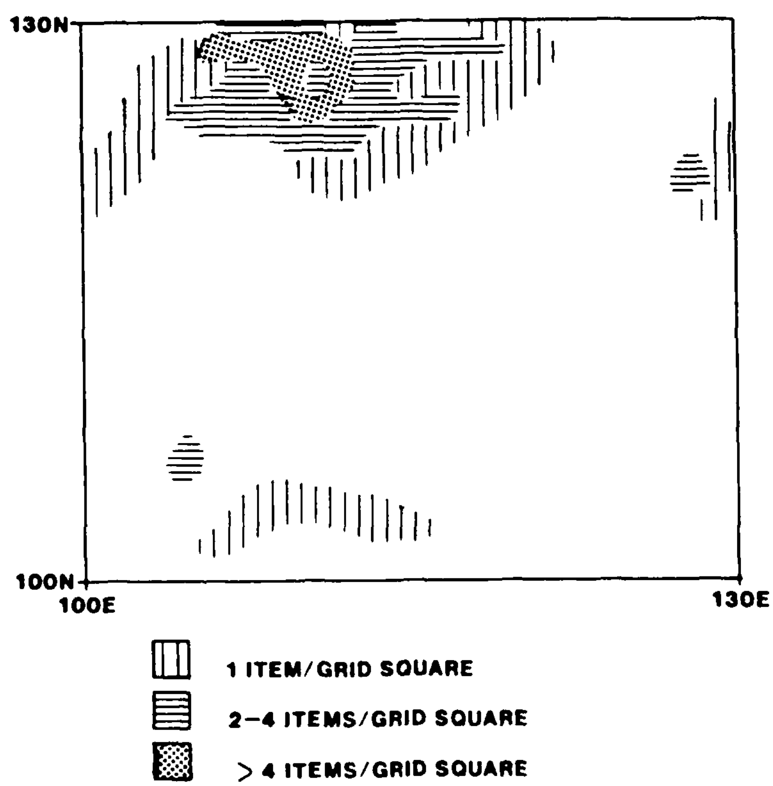


Figure 9.4 LA 27002, Density Contour Plot of Biface Flakes, Abiquiu Archaeological Study, ACOE, 1989.

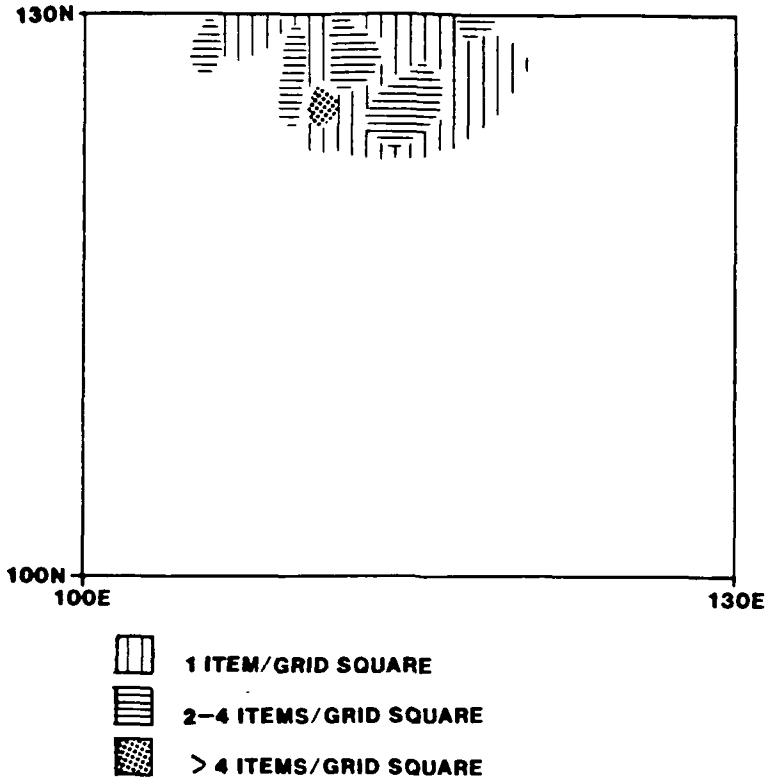


Figure 9.5 LA 27002, Plot of Tools, Abiquiu Archaeological Study, ACOE, 1989.

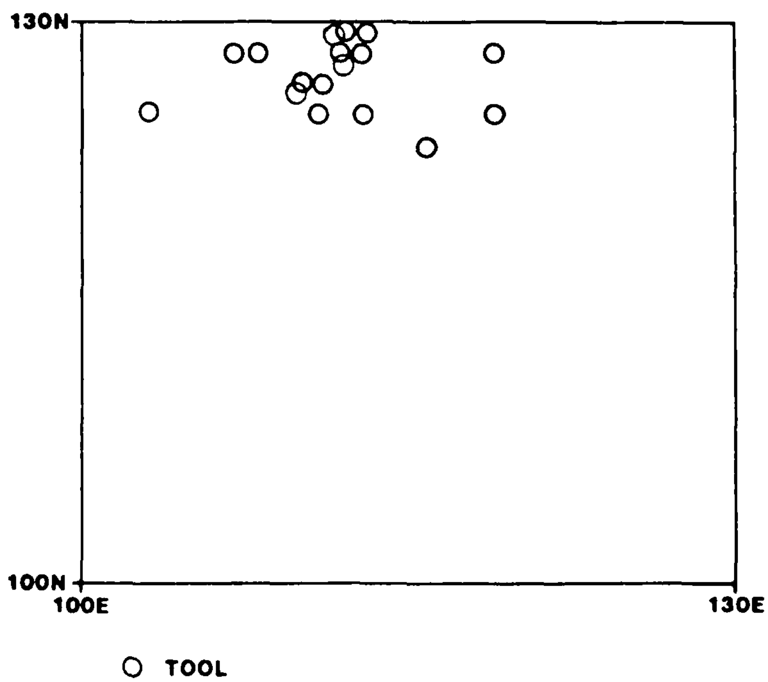
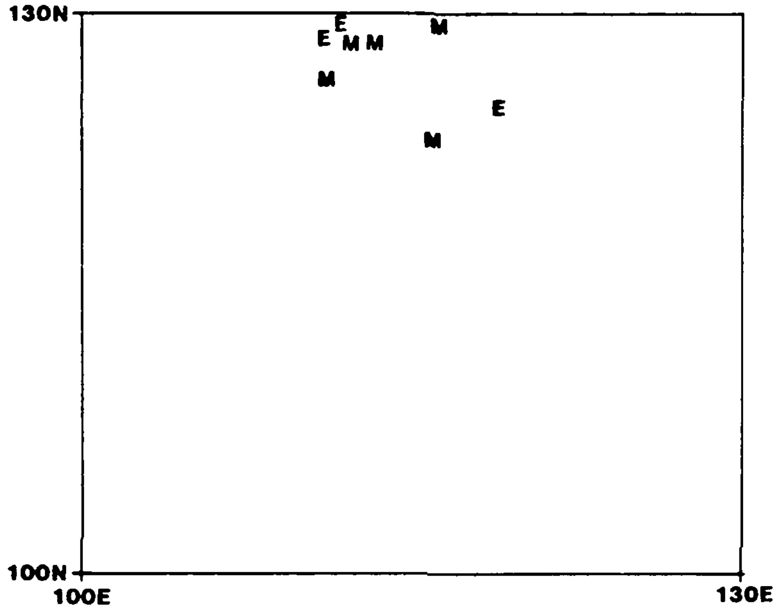


Figure 9.6 LA 27002, Plot of Dates, Abiquiu Archaeological Study, ACOE, 1989.



M EN MEDIO PHASE 800 BC—AD 500

E EARLY DEVELOPMENTAL PERIOD AD 500—900

The distributional information for this site suggests a number of interpretations. First, a Pedernal chert reduction area is indicated by the seven flakes in the south central part of the unit and the core to the northwest. This reduction area is undated. Second, most artifacts occur in the north central portion of the collection unit; this area was the location for a number of activities, including core reduction and tool production. These activities are dated to the En Medio Phase and Early Developmental Period, but not in a spatially distinct fashion. While there are only two known components and the total assemblage is small, neither the components nor the activities are spatially well segregated.

Postdepositional processes that may have affected artifact distributions noted above are detailed here. The collection unit was placed to include most artifacts within the concentration but to exclude those materials below a major slope change at the mesa edge; these latter materials were judged to be slope washed. Artifacts within the collection unit are deposited on bedrock with overlain gravels and thin sands. The mesa itself is a broad, relatively flat one. Trees are scattered throughout the collection unit and downhill to the south. A two-track road crosses the unit from east to west and primarily impacts the south half. It is notable that no artifacts occur in the general vicinity of the road and that the concentration occurs downslope from the road. The slope is from south down to the north.

The distribution of artifacts of different size categories may suggest whether postdepositional processes such as slope wash have affected the artifacts in the collection unit. The downhill study (Chapter 10) found that dense artifact concentrations tend to have larger artifacts and represent lag deposits that have experienced less abrasion than artifacts downslope, which have often been sheet washed and show evidence of greater abrasion. While the LA 27002 materials provide no information on size or abrasion, the debitage and tool categories can be used as a crude indicator of size. Large angular debris and cores are the largest size class, followed by tools (including six bifaces, one uniface, and two points) and debitage. Since the north central portion of the unit has been identified as an artifact concentration, this area will be compared with other portions of the unit in terms of the size classes.

Two of the three cores and pieces of large angular debris occur in the north central concentration, and one occurs midway between this concentration and the low density cluster in the south central portion of the unit. Tools also occur in the concentration or at its immediate periphery. The smaller items such as core and biface flakes and small angular debris also occur with greatest intensity in the north central concentration. The limited data on size do not support any size sorting of deposits. Moreover, the obsidian dates for En Medio Phase and Early Developmental Period occupation are limited to the dense concentration in the northern portion of the collection unit. The relatively limited spatial and temporal range for these dates does not suggest that the dense concentration represents a long-term lag deposit, although dates would have to be obtained for downhill materials for more reliable confirmation.

The crude artifact size categories do not suggest that slope wash was an important contributing factor to the dense artifact concentration in the north central portion of the unit. The absence of artifacts in the area of the road suggests that this modern feature reduced artifact densities in the southern portion of the central section of the unit.

9.2.3.2 LA 25480

On LA 25480, the collection units were established near the southern site boundary in an area of high surface artifact density; artifacts were located on and within 80 m of the canyon edge. The mesa edge slopes to the south and sharply toward the east to the north fork of Comanche Canyon. Surface collection Unit 1 was placed closest to the steep slope; sandstone bedrock was exposed throughout the unit, and sand deposits appeared shallow and unstable. Unit 2 was placed on stable sandy loams with exposed patches of bedrock. Unit 3 was located on stable loams with only two small areas of exposed bedrock. Unit 4 was located entirely on stable loams; this unit was the farthest from the canyon edge

Pedernal chert comprised 41 percent (1,459 pieces) of the lithic assemblage, while Polvadera obsidian was equally 41 percent (1,443 pieces) and Jemez obsidian was 17 percent (601 items). All four units of the site had low percentages of Pedernal chert. The site was unusual in that 87 percent of core flakes were heat treated, in addition to the 94 percent of biface flakes.

Figure 9.7 shows the distribution of all debitage on LA 25480. Highest artifact densities are in Units 1 (east and west portions) and 2 (east and west portions), and, to a lesser extent, Unit 3 (northwest portion). Artifact densities do not appear to correlate either negatively or positively with bedrock outcrops, although the low density area in the south part of Unit 3 may relate to the brush fence, which does not, however, appear to have affected densities in Unit 4, which it also crosses.

Examination of Figures 9.8 and 9.9 shows the distribution of cores and large angular debris and core flakes. Cores and large angular debris tend to occur in clusters with two to four core flakes per grid square. In Units 3 and 4, the cores were Pedernal chert, consistent with its predominance (54 percent) in the low to moderate density portions of these units, while the two cores in the northwest portion of Unit 1 were made of Polvadera obsidian, consistent with this material type's predominance (68 percent) in this portion of Unit 1. Concentrations of core flakes occurred in the high density areas described for all debitage, but unlike on LA 27002, core flakes do not comprise the majority of the dense concentrations identified from the debitage plot (Figure 9.7).

In contrast to LA 27002, biface flake concentrations on LA 25480 generally occur in the same place as core flakes (Figure 9.10). Tools and ground stone (there are five pieces of ground stone) also tend to occur in these same areas (Figure 9.11). The exceptions are the six tools north of the cluster of one biface flake/grid square in the center of Unit 4 and the six tools in the eastern portion of Unit 1.

Figure 9.7 LA 25480, Density Contour Plot of All Debitage, Abiquiu Archaeological Study, ACOE, 1989.

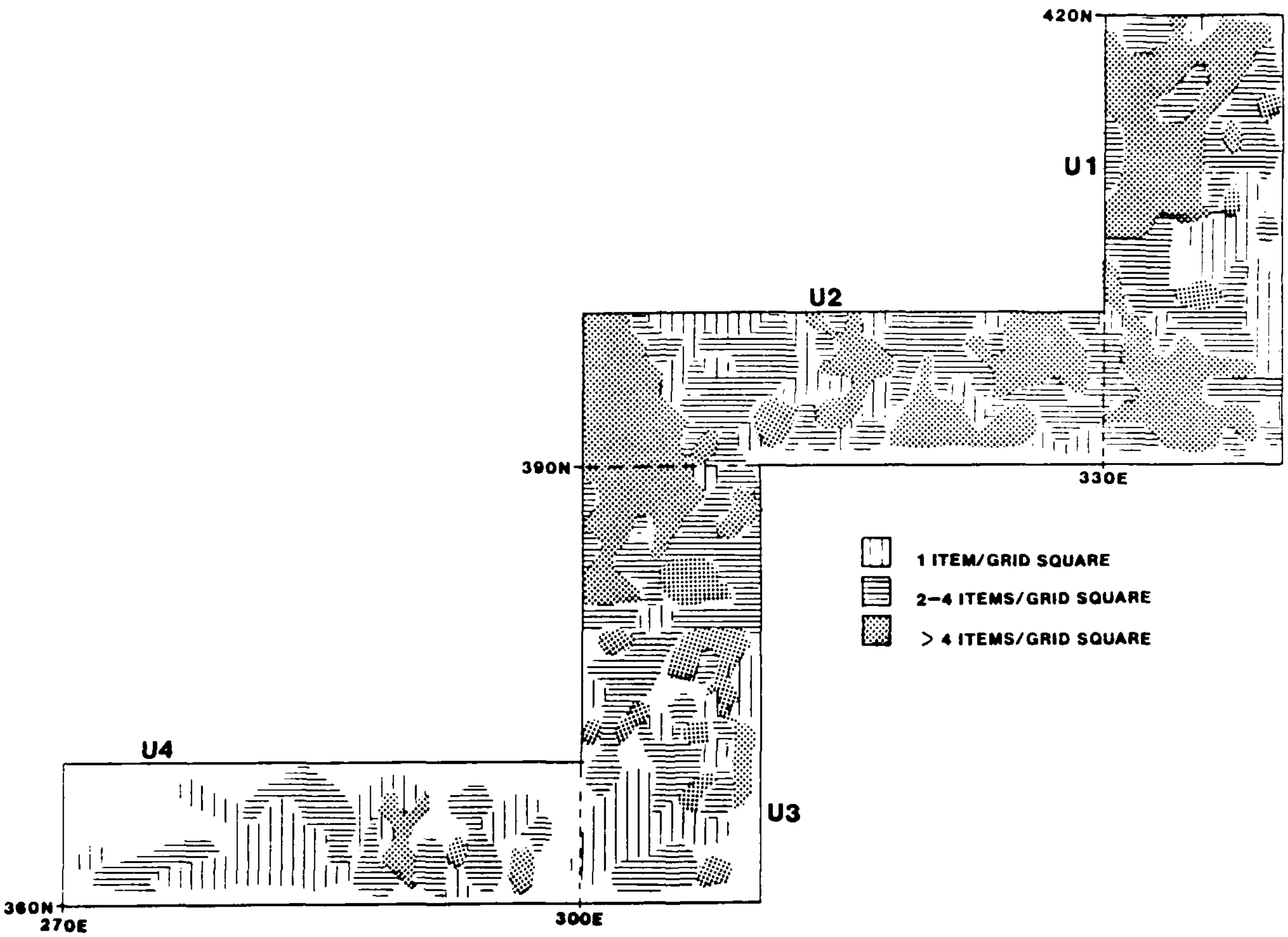


Figure 9.8 LA 25480, Plot of Cores and Large Angular Debris, Abiquiu Archaeological Study, ACOE, 1989.

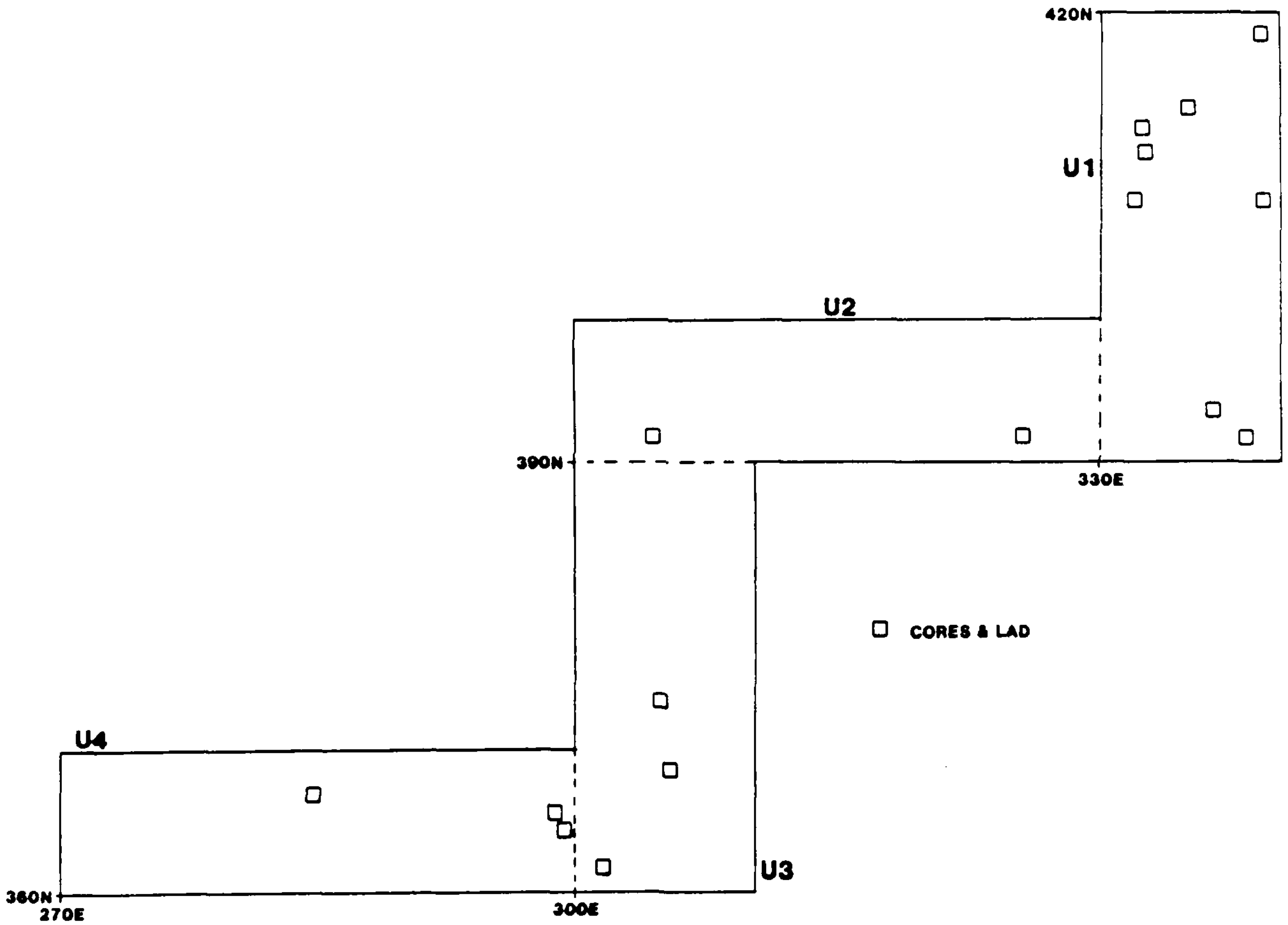


Figure 9.9 LA 25480, Density Contour Plot of Core Flakes, Abiquiu Archaeological Study, ACOE, 1989.

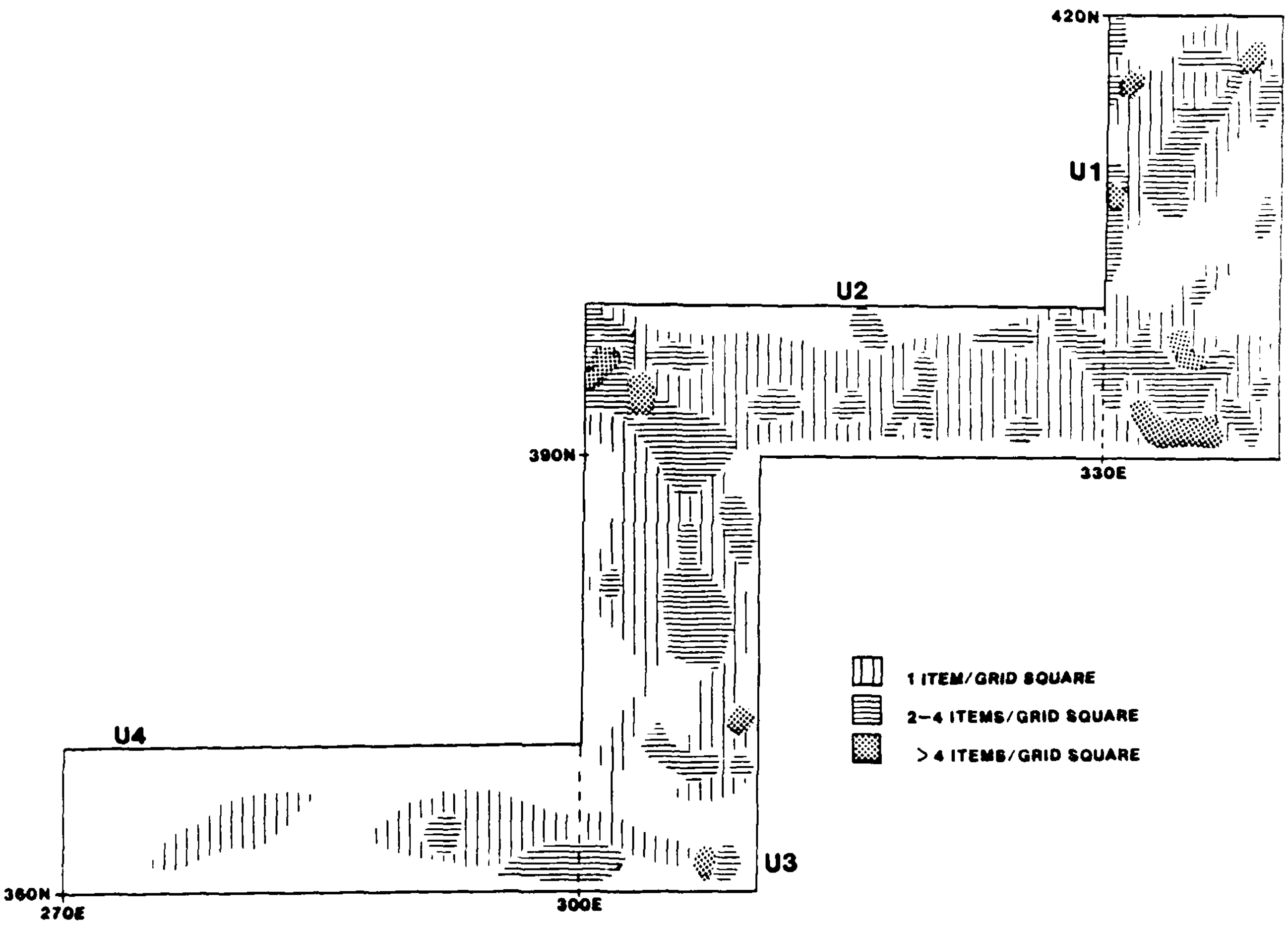


Figure 9.10 LA 25480, Density Contour Plot of Biface Flakes, Abiquiu Archaeological Study, ACOE, 1989.

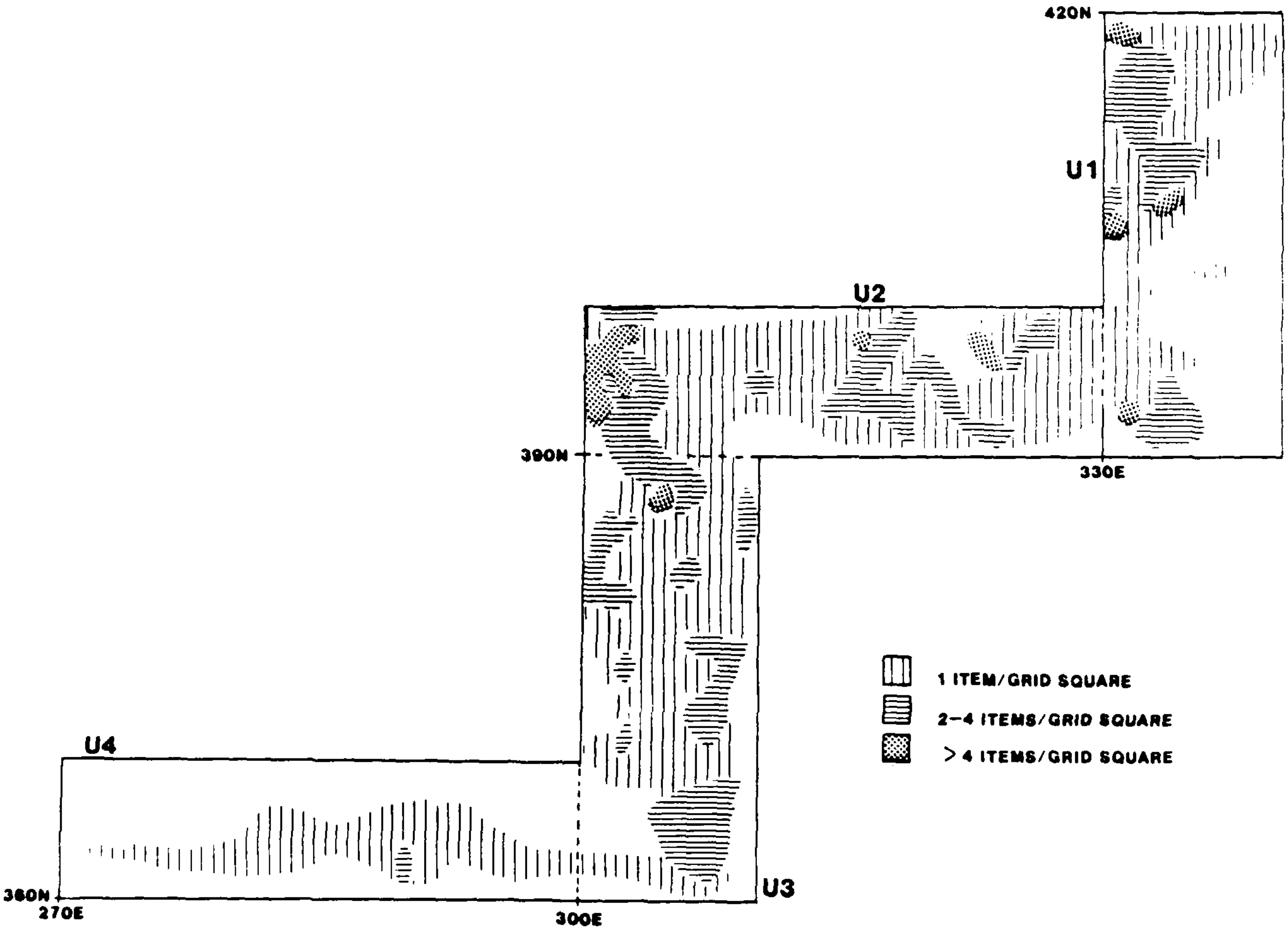
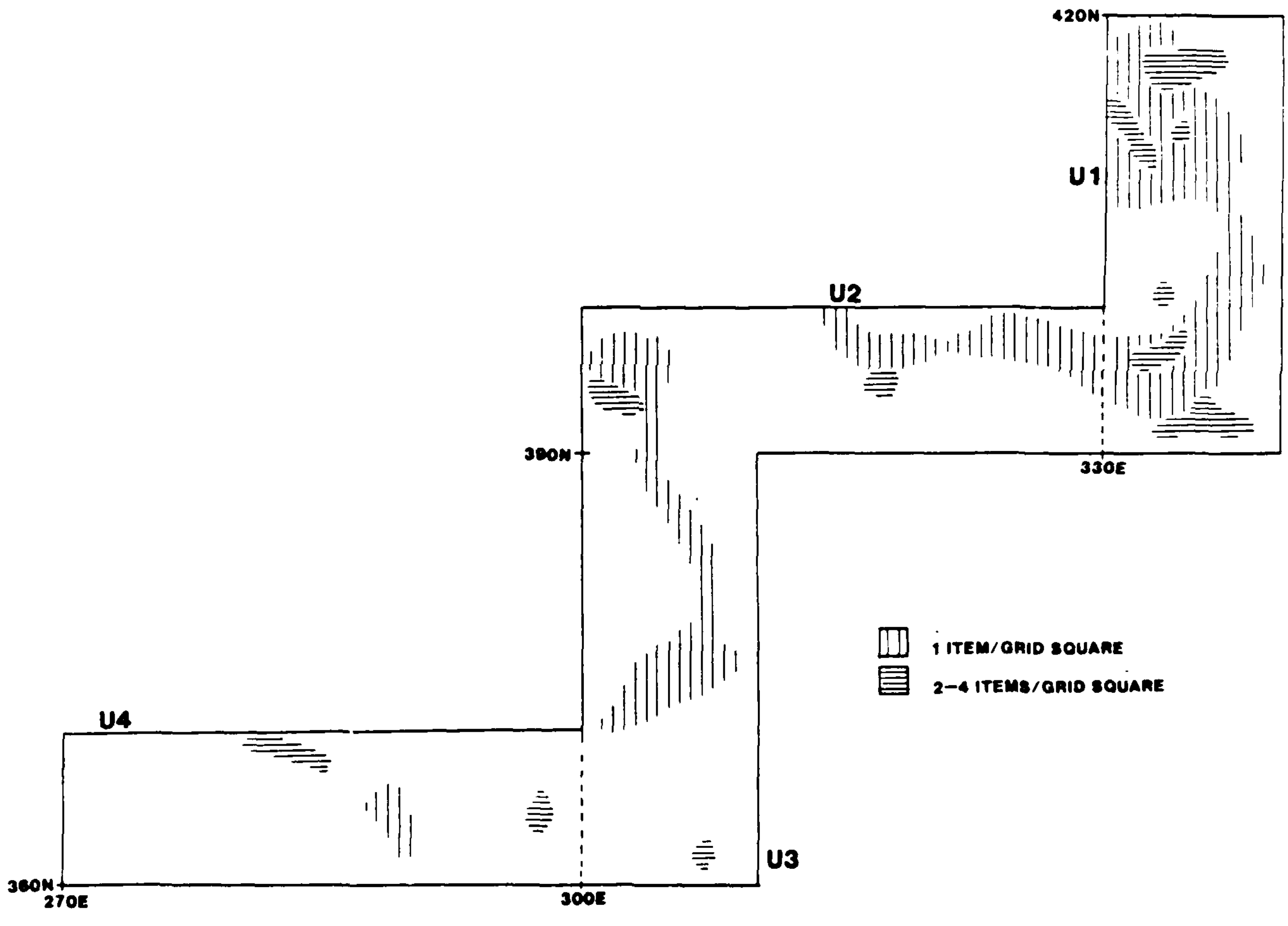


Figure 9.11 LA 25480, Density Contour Plot of Tools and Ground Stone, Abiquiu Archaeological Study, ACOE, 1989.



The dates from this site are from obsidian hydration (38 readings), points, and sherds and reflect six occupations. Obsidian dates are shown in Figure 9.12. There are En Medio dates scattered throughout the four units; two En Medio clusters contain four dates in the south portion of Unit 1 and three dates in the northwestern portion of the same unit. Early Developmental Period dates occur in the same two areas. There are five Late Developmental dates scattered throughout Units 1 and 2. The greatest range of dates, from Armijo Phase to the Historic Period (Penasco Micaceous sherds) occurs in the dense concentration in the northwest portion of Unit 1. As an indicator of the overlap in dates of different periods, there are four periods or phases represented in the 6 x 10 m area in the south of Unit 1 and six (discounting the pre-PaleoIndian date) in the 5 x 5 m area in the northwest portion of this unit. While there seem to be areas which have a cluster of dates from one period or phase, these areas also contain a multitude of earlier and later dates, which makes it extremely difficult to distinguish activity areas from any one period.

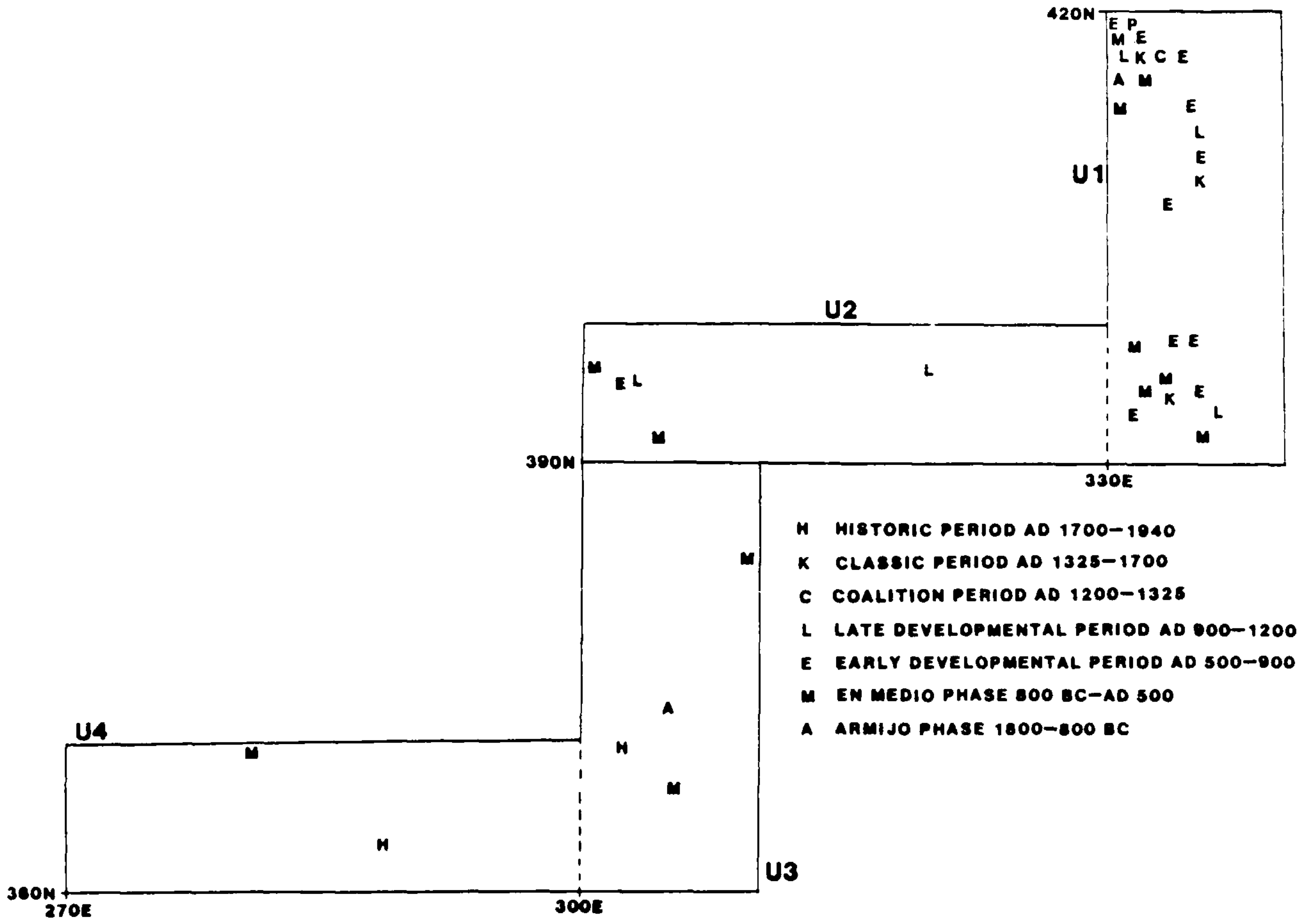
Unlike LA 27002, no definite reduction areas could be identified on LA 25480. Like the smaller site, however, most dates are available for high density areas, making it particularly difficult to identify areas of high spatiotemporal integrity.

Postdepositional processes that may have affected the assemblage are discussed here. A possible wagon road is approximately 20 m to the west and probably has not affected the site greatly. As was mentioned above, a brush fence crosses Unit 4 and the southern part of Unit 3 but does not appear to have reduced artifact densities in its vicinity. In terms of crude size categories that may indicate the potential for slope washed deposits, the results are as follows. The smallest size class, biface flakes, generally clusters in the same areas as the larger core flakes. Chipped stone tools and the five pieces of ground stone have the same distribution, with the exceptions of the six tools in the center of Unit 4 and the six tools in the east portion of Unit 1. The same is generally true for cores and large angular debris. Thus, the distribution of different-sized categories of artifacts is very similar, suggesting that little size sorting has occurred. As was noted above, the dates support an accumulation of materials dating from a wide range of periods in the dense concentrations of materials in Units 1, 2, and 3.

9.2.3.3 Comparisons

Artifact distributions on these two sites that differ greatly in terms of location, artifact density, size, and range of dates and artifact types are usefully compared and contrasted. In terms of all debitage, LA 27002 has the more distinct concentrations, with most artifacts clustered in the north central part of the collection unit and a small cluster in the south and remaining grid squares generally devoid of materials. The greater density at LA 25480, as shown by the plot of all debitage, shows very few empty grid squares, by contrast, so that artifact distributions approach clinal rather than discrete cluster models. On LA 27002, one of the three cores and pieces of large angular debris is spatially associated with a small cluster of core flakes in the south part of the collection unit. On LA 25480, however, cores

Figure 9.12 LA 25480, Plot of Dates, Abiquiu Archaeological Study, ACOE, 1989.



tend to occur in high density areas along with biface and core flakes, tools, and ground stone.

When the dates are taken into account, the potential of these sites for distinguishing activity areas can be assessed. On LA 27002, the simpler of the two in terms of artifact density and range of dates (only two phases or periods represented), the obsidian dates indicate occupation in the En Medio Phase and Early Developmental Period. Taken in isolation, the dates are clustered tightly in a 10 x 7 m area; however, when artifact densities are considered, it becomes clear that the densest concentration of artifacts is coterminous with the cluster of dates. In this situation, it becomes difficult to relate artifact types to particular occupations, when tools, biface flakes, and core flakes all tend to occur in the cluster. On the other hand, the apparently discrete southern cluster composed of Pedernal chert is unassociated with dates.

The situation is even more complex for LA 25480. Artifact distributions show that all categories of artifacts, biface and core flakes, tools, and cores and large angular debris, tend to occur in the same areas with rare isolated clusters of one particular artifact type indicating an activity area or functionally specific location.

The dates tend to be concentrated in the same dense areas. On the western part of the collection units, there is no homogeneity of dates in particular locations. In the date clusters in Unit 1, on the other hand, En Medio and Early Developmental groups can be identified, but interspersed are dates from other periods, such as the Late Developmental, Coalition, and Classic. As with LA 27002, the dates are from artifact concentrations, making it difficult to associate particular artifact types or assemblages with particular occupations.

There are definite problems with defining activity areas, recomposing assemblages, and determining which artifacts belong to which occupations on these kinds of sites. LA 27002 was chosen as a best-case example of a low density, one- or two-occupation assemblage. When proveniences of different artifact types were examined, the best dated areas were those with the densest artifacts, which in turn made interpretation difficult. Because most dates for both of these sites were on obsidian, the clustering is partially artificial, since obsidian clusters were preferentially selected for dating over isolated pieces of obsidian. This practice is supported as a means of cross-checking the consistency of obsidian dates.

The Abiquiu sites suffered from a lack of features to provide the basis for artifact associations. The paucity of such dateable thermal features (10 surface and subsurface features in the entire project area) meant that there were few independent cross-dates for obsidian and that there were few cultural features to use as a basis for testing whether artifact concentrations were structured by presence of a hearth. The two sites selected were typical of this data set of 18 sites in not containing any thermal features. Unfortunately, other sites with clearly structural features were dated to the Historic Period (e.g., Piedra Lumbre structures on LA 27020 and LA 51698), which obsidian suggests was not the primary occupation period on most of these

sites, or were not completely mapped due to impending collapse into the reservoir (LA 51699). Thermal features can serve to tie the lithic assemblage into the site structure and provide meaningful definition of activity areas on the basis of distance from such features.

The difference in interpretive power is clearly indicated by the results of another study by MAI (Earls et al. 1989) at three cobble ring sites in Abiquiu Reservoir, northwest of the present project area. There were differences in depositional environment at these cobble ring sites, most clearly evident in the abundance of thermal features, not all of which were deflated. In addition to the thermal features, there were numerous cobble rings at these sites. While association of artifacts with these features was difficult because of the limited amount of testing, the features easily lent themselves to behavioral interpretations, and definite patterns of differing artifact density served to distinguish different classes of cobble rings. Consideration of obsidian and artifact cross-dates was the basis for contrasting widely spaced rings of particular shapes and sizes dating to a number of periods on one site with more clustered rings dating to the same period on a portion of another site. While the cobble ring sites were nearly as strongly multicomponent as the sites in the present study, the presence of structures and features and the generally lower artifact densities on the cobble ring sites made interpretations of and pattern recognition on these kinds of sites more firmly based.

Multicomponency, then, does not mean that interpretation is impossible. It is much better to have many dates than to have only a few and to be lulled into thinking that a site is single-component when it is not. The high artifact densities on most of the Abiquiu Reservoir sites (and the tendency for materials to occur in clusters containing many different artifact types and with obsidian dating to different periods) make it difficult to recompose activity areas or subsite assemblages. However, the project area does represent a topographically varied portion of the reservoir; broadening the perspective to differences in land use by period may result in detection of more meaningful patterns of past human behavior. These patterns are discussed in Chapter 12.

10.0 INVESTIGATION OF DOWNSLOPE MOVEMENT OF ARTIFACTS ON LA 27018

Steven Kuhn with Jack B. Bertram

10.1 INTRODUCTION

LA 27018 is situated on a long, relatively steep slope with thin soils which appear unstable. One would naturally expect that considerable artifact movement had occurred in such a context, and it is common to assume that artifactual materials are not in situ. In this study, an attempt was made to explicitly investigate patterns of artifact movement and the relative integrity of surface distributions. Two basic issues were addressed: 1) the scale and pattern of downslope movement of artifacts, and 2) whether high density areas represent the remnants of an activity zone or simply a topographically or vegetationally conditioned catch basin for artifacts moving downslope. The study was based largely on metric attributes which are commonly recorded in detailed analyses of lithic materials from prehistoric archaeological sites.

10.2 METHODS

The data used in this study were obtained from an 8-m wide (north to south) by 90-m long (east to west) surface collection transect, termed surface Unit 1. This transect is oriented along the axis of the slope at LA 27018, with elevations increasing from west to east. Grid coordinate 100E represents the lowest portion of the area sampled, while coordinate 190E represents the highest. A total of 2,339 artifacts was recovered from the surface collection transect. A subset of 1,043 artifacts, representing the contents of a 4-m wide strip along the center of the entire transect (N102-106/E100-190), was selected for analysis in this study. In addition to the technological attributes noted in conjunction with standard detailed lithic analyses in this project, the following attributes were recorded for the sample under discussion: 1) length, width, and thickness for <u>all</u> pieces, regardless of condition, and 2) subjective measures of degrees of dorsal and ventral abrasion on obsidian artifacts. The first set of measures was collected in order to construct composite size and shape measures to be used in investigating the effects of hydrological and gravitational movement.

The second set of attributes was recorded as an experiment in independent assessment of the distances over which individual artifacts had moved. It was hypothesized that abrasion should increase as a function of the distances which materials have traveled over a rocky or sandy substrate. All artifacts from the sample transect were examined under a 30-power binocular microscope for traces of abrasion or scratching on their dorsal and ventral surfaces. The following numerical code was used to classify abrasion in an essentially ordinal sequence: a 0 was coded for pieces with no abrasion; a 1 represented isolated scratches on ridges and projections but not flake scar troughs; a 2 signified light abrasion on ridges and projections and isolated or no scratches on flake scar troughs; a 3 indicated moderate abrasion on ridges and projections and isolated to light abrasion on flake scar troughs; a 4 meant heavy abrasion on ridges and projections and light to moderate abrasion on

flake scar troughs; and a 5 signified heavy abrasion on ridges and projections and flake scar troughs.

The composite measures used in this study were quite straightforward. A size or volume measure was obtained by simply multiplying length, width, and thickness of each artifact. An estimate of shape was calculated by dividing the maximum measure by the minimum measure. An index of flatness was thus obtained, varying from 1 (spherical or cubic) to infinity (a perfect zero thickness plane): in reality this measure ranged from around 1 to 20. A log-normal distribution was observed in the original shape and size distribution histograms, and natural log values of the size and shape variables were used in subsequent calculations to provide an approximately normal distribution of the variables.

10.3 ASSUMPTIONS AND HYPOTHESES

This study was based on the assumption that lithic artifacts may be treated as simple sedimentary particles in the context of examining patterns of artifact movement. It was further assumed that two basic sets of forces -- gravity and water action -- would act to move artifacts downslope. The recent taphonomic literature contains a large number of references dealing with the effects of water action on the distribution and movement of archaeological materials (Behrensmeyer 1976, Hanson 1980, Voorhies 1969). Unfortunately, most studies published to date focus on faunal remains in relatively high energy aquatic situations, and no experimental results currently exist which report on either lithic materials or the effects of low energy water flow or gravity as a mover of artifacts. Thus, researchers are limited to simple deductive predictions about the effects of water and gravity on the movement of artifacts. Given the relatively small range in lithic artifact density, it is assumed that the differential effects of water action will be reflected primarily in size sorting of artifacts. In keeping with the results of taphonomic studies of water sorting in bones, extremes in shape are also assumed to affect water transport; in particular, the flattest, most streamlined pieces will tend to be transported most frequently and over the greatest distances by water. The effects of gravitational action are expected to be complementary to those of water. Gravity affects objects independent of mass (or size), and gravitational movement is assumed to be differentially expressed in terms of shape. Simply stated, round objects (those with low shape indices) are expected to move more readily and over greater distances than flat objects (those with high shape indices).

The study of downhill movement of artifacts at LA 27018 may be framed in terms of a series of binary hypotheses which can be addressed using the data on artifact size, shape, and surface abrasion. The most basic question which must be addressed is whether the artifacts collected were originally deposited on the slope, or whether they have all washed or rolled down from above. A level area of stable soils with no visible surface artifacts was observed in the field immediately east (uphill) of the study transect, and possibly all materials collected moved downhill from a buried or eroded archaeological deposit in this area. If this were the case, a pattern of size or shape sorting of artifacts with increasing distance downhill from the source would be predicted. An inspection of the scatter plots in Figures 10.1 and 10.2

Figure 10.1 Site LA 27018 Artifact Scatter Plots, Abiquiu Archaeological Study, ACOE, 1989.

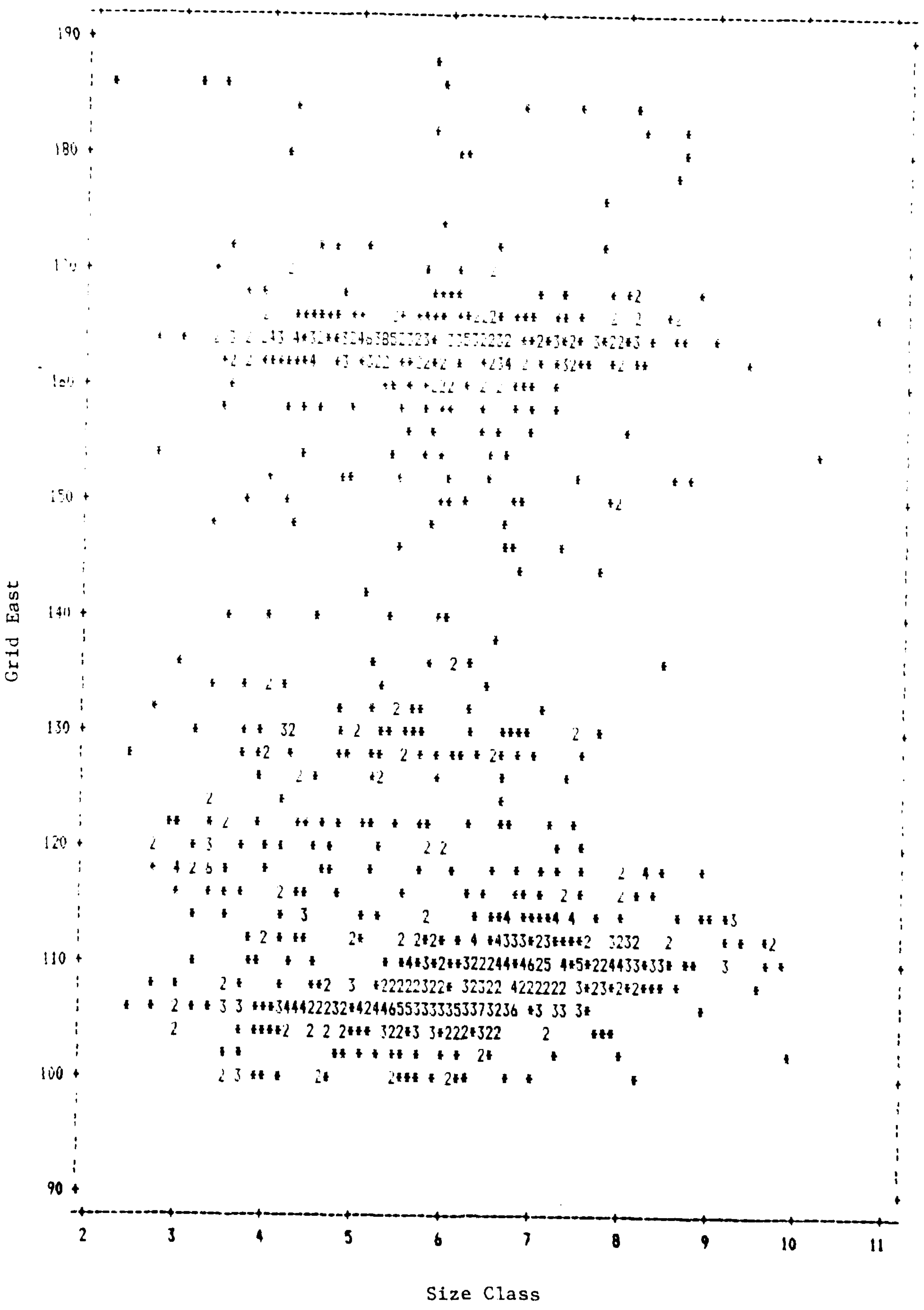
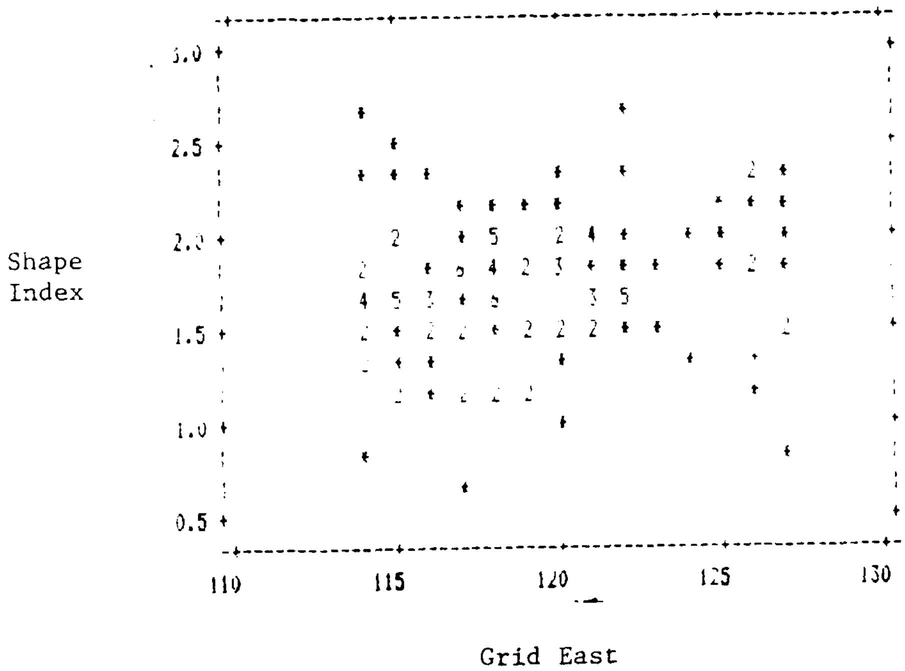
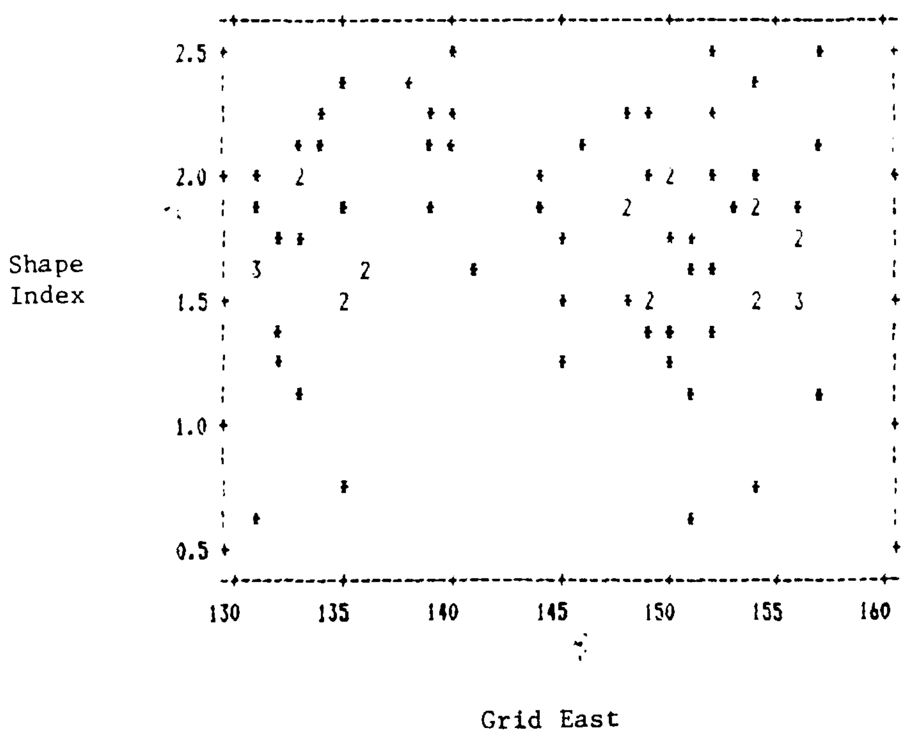


Figure 10.2 Site LA 27018 Artifact Scatter Plots, Abiquiu Archaeological Study, ACOE, 1989.





reveals no obvious pattern in size or shape with decreasing east coordinates (i.e., moving downhill) nor the site as a whole. The correlations among size and distance downhill and shape and distance downhill approach zero ($r=0.058$ and 0.019, respectively). It does not seem possible to reject the hypothesis that the artifacts observed were originally deposited at some point along the slope.

10.4 RESULTS

Inspection of artifact densities for the study transect reveals significant variation in density across the east-west dimension. Two relatively high density areas (5-12 artifacts/m^2) can be observed, along with surrounding areas of low density (0-4 artifacts/m^2). These variable density zones were used to create provenience units for the artifact analysis. The next basic hypothesis to address relates to whether the observed high density zones represent the remnants of prehistoric activity/occupation, or whether they represent topographic or vegetative catchments for materials moving downslope.

For purposes of simplifying this analysis, the entire collection transect was divided into a series of high and low density zones (Table 10.1). To bring additional clarity to the analysis, the size and shape variables were grouped into five and six categories, respectively. Finally, a new variable was derived which combined both size and shape, after analysis revealed that these two variables were not independent, but in fact partially negatively correlated (flat pieces tended to be smaller, round pieces larger). An inspection of the codistribution of size and shape revealed that three natural, distinct groupings existed (groups cannot be described metrically because they consist of <u>indices</u> derived from artifact measurements). Size/shape group 1 consists of very small, flat flakes and flake fragments. Size/shape group 2 includes moderately small, thin flakes, predominantly identified as biface flakes. Size/shape group 3 consists of a relatively thicker, less flat group of core flakes, cores, artifacts, and angular debris, in which size and shape appear to be independent.

Tables 10.2, 10.3, and 10.4 show the frequencies and relative frequencies of each size, shape, and combined size/shape group for each of the density zones. As the tables indicate, the various groupings are neither evenly nor randomly distributed. When the two high density areas (zones 2 and 8) and the adjacent low density areas are examined, a number of patterns emerge. With regard to size, the high density zones show a distinctly lower proportion of the smallest group (1) compared with low density zones immediately downhill from them. Conversely, the dense zones show a somewhat higher proportion of the largest size grouping present in significant quantities (4) than the low density zones. The intermediate sizes of artifacts seem randomly distributed. In regard to the distribution of artifacts according to shape, a complementary pattern is present. The two high density zones show a slight overabundance of round artifacts (those with a low size index) and a distinct underabundance of very flat artifacts (shape grouping 2.5) compared with adjacent, downhill low density zones. Again, artifacts in the middle category show little strong patterning. This pattern of different distributions for different size or shape classes is repeated once more in the distribution of the three composite size/shape groups. Small, flat artifacts are infrequent in high density zones

Table 10.1 High and Low Density Zones on the Downhill Transect, Abiquiu Archaeological Study, ACOE, 1989.[1]

Zone	Range of East Coordinates	Artifact Density	Equivalent Provenience Unit
1	100-103	low	Provenience #3
2	104-113	high	Provenience #4
3	114-127	low	Provenience #3
5	128-130	moderate	Provenience #3
6	131-157	low	Provenience #1
8	158-168	high	Provenience #2
9	169-187	low	Provenience #1

1 Coordinates of density zones and provenience units are not isomorphic, since they were constructed for different purposes and using different data sets.

Table 10.2 Size Group Frequencies by Pooled East Provenience Group, Abiquiu Archaeological Study, ACOE, 1989.

	Pooled East Provenience Group							
Size Group	1	2	3	5	6	8	9	Total
1	10	26	41	4	10	24	5	120
2	21	151	41	21	34	124	12	404
3	15	217	35	15	28	102	10	422
4	3	53	10	--	4	20	5	95
5	--	--	--	--	1	1	--	2
Total	49	447	127	40	77	271	32	1,043

Table 10.3 Shape Group Frequencies by Pooled East Provenience Group, Abiquiu Archaeological Study, ACOE, 1989.

Shape Group	Pooled East Provenience Group 1	2	3	5	6	8	9	Total
0.5	1	5	--	--	--	2	--	8
1	2	26	4	4	4	23	2	65
1.5	12	163	35	10	21	80	9	330
2	21	189	70	13	34	116	10	453
2.5	13	60	16	11	18	46	9	173
3	--	4	2	2	--	4	2	14
Total	49	447	127	40	77	271	32	1,043

Table 10.4 Size Shape Group Frequencies by Pooled East Provenience Group, Abiquiu Archaeological Study, ACOE, 1989.

Size Shape Group	Pooled East Provenience Group 1	2	3	5	6	8	9	Total
1	14	49	47	9	19	47	11	196
2	14	104	32	14	18	69	3	254
3	21	294	48	17	40	155	18	593
Total	49	447	127	40	77	271	32	1,043

2 and 8, and frequent in low density zones 9, 6, 3, and 1, while the larger, rounder items show the opposite distribution.

The discussion and tables presented above clearly point to a density and elevation dependent distribution of artifacts according to size and shape. Dense areas contain low numbers of small and very flat artifacts, while the adjacent low density areas contain an overabundance of these same items. The original assumptions and deductions about the effects of water and gravity on artifact movement contribute to two competing hypotheses. The dense areas could represent 1) the remains of more or less in situ deposits from which water action had removed most mobile elements, very small pieces, and very flat pieces, or 2) natural traps for round objects moved downhill by gravity.

The data presented thus far tend to support the water transport hypothesis, in that it is difficult to explain the observed variation in artifact size in terms of gravitational effects. Supporting data are needed, however. There are a number of ways in which these two competing hypotheses may be tested. The most direct, for the purposes of this study, is to employ the data recorded for dorsal and ventral abrasion of artifacts. Tables 10.5 and 10.6 present the relative frequencies of different dorsal and ventral abrasion groups on obsidian artifacts in the different zones within LA 27018 (abrasion was rarely detected on chert artifacts). The nature of these abrasion categories is discussed in greater detail in Chapter 5. Generally, the abrasion codes may be viewed as a rank order sequence, ranging from no abrasion (code 0) to heavy, all-over abrasion (code 5). As the tables clearly show, the two dense zones (zones 2 and 8) show a higher percentage of unabraded pieces and a lower percentage of abraded pieces (in those categories for which sufficient nonzero cells are present) than do the low density zones on the downhill sides. This pattern is especially clear for ventral abrasion, which is a somewhat more secure measure, since it must occur subsequent to the detachment of a flake (ruling out abrasion prior to reduction and produced by transport and use as opposed to abrasion occurring as part of lithic reduction).

The data on abrasion clearly suggest that artifacts present in the two dense zones in the LA 27018 transect (zones 2 and 8) have been subject to less abrasion than those in the adjacent low density zones. This result clearly supports the hypothesis that artifacts in the dense zones represent lag deposits from a prehistoric occupational or activity zone in the vicinity. These data also imply that the low density zones downhill from these concentrations represent materials transported primarily by water action, probably sheet wash. The absence of significant variability except at the extremes of the shape and size ranges may be due to the low energy nature of this process.

The methods outlined here appear to have potentially beneficial results for the analysis of spatial patterning in surface deposits at archaeological sites. Useful and informative patterning has been recognized from relatively coarse-grained provenience data and simple descriptive statistical techniques, using commonly collected attribute data. The patterning observed is clear in broad terms, but additional uncontrolled variables probably contribute to a lack of detail in the trends. It is the opinion of the investigators that additional data concerning small-scale variation in slope, soil type/sta-

Table 10.5 Dorsal Abrasion Frequencies by Pooled East Provenience Group, Abiquiu Archaeological Study, ACOE, 1989.

Dorsal Abrasion	Pooled East Provenience Group							Total
	1	2	3	5	6	8	9	
0	38	379	112	30	64	253	31	907
1	7	39	9	5	6	13	1	80
2	--	6	2	--	--	3	--	11
3	4	16	4	3	5	2	--	34
4	--	7	--	2	1	--	--	10
5	--	--	--	--	1	--	--	1
Total	49	447	127	40	77	271	32	1,043

Table 10.6 Ventral Abrasion Frequencies by Pooled East Provenience Group, Abiquiu Archaeological Study, ACOE, 1989.

Ventral Abrasion	Pooled East Provenience Group							Total
	1	2	3	5	6	8	9	
0	32	378	112	32	64	256	29	903
1	16	65	15	7	13	13	3	132
2	--	1	--	--	--	1	--	2
3	1	--	--	1	--	1	--	3
4	--	3	--	--	--	--	--	3
Total	49	447	127	40	77	271	32	1,043

bility, and vegetative cover could contribute greatly to the explanatory power of these techniques.

10.5 IMPLICATIONS

Study of the effects of gravity and water action on artifacts considered as sedimentary particles will profit by continued experimental studies of these processes. The use of facial abrasion as an indicator of artifact movement is a somewhat less secure method, though, ultimately, a necessary one if independent confirmation is sought.

A small sample of obsidian artifacts from another site (LA 25328) was analyzed to provide some control over the results from LA 27018; these artifacts were recovered from a very flat, sandy locale and were unlikely to have been subject to any transport. The obsidian artifacts from the control sample showed a higher overall frequency of abrasion than all but the most abraded zones at LA 27018. The high frequency of abrasion on artifacts from LA 25328 is probably the result of blowing sand and/or trampling by cattle in a sandy matrix. In any event, the comparison suggests that absolute levels of abrasion are not necessarily reflective of artifact movement, and that a more appropriate indicator is the relative levels of abrasion within zones where trampling and abrasion by windblown material can be assumed to be constant.

One additional implication of the results obtained in this study is that the processes of gravitational and hydrological sorting are likely to have differential effects on different types of technological debris. For example, the extreme small and flat size/shape categories were composed primarily of biface reduction and manufacture flakes and fragments of what were probably the same. These artifacts appear to manifest the spatial sorting effects of water action in the most extreme degree. It appears that relatively low energy, unobtrusive processes can be responsible for producing artificial activity or reduction areas within artifact distributions. Caution should be exercised in interpreting such distributions where the sorting and redistributive actions of hydrological and gravitational processes cannot be ruled out.

11.0 ABIQUIU CERAMICS AND HISTORICAL EVIDENCE OF JICARILLA APACHE POTTERY MANUFACTURING

Charles M. Carrillo

The present analysis represents an effort to identify the ceramics recovered during excavation at Abiquiu Reservoir. A total of 470 sherds was recovered from eight sites (Table 11.1).

Table 11.1 Sites Containing Ceramics, Abiquiu Archaeological Study, ACOE 1989.

LA Number	Number of Sherds
51703	73
27020	63
25333	274
25532	20
25480	16
51698	1[1]
51701	1
51700	22

[1] Also present were two extremely eroded sherds or possible adobe daub.

11.1 PREVIOUS RESEARCH

To provide an understanding of the ceramics of the Abiquiu Reservoir area, a brief overview of previous work is necessary. Fieldwork by Schaafsma (1975a, 1979), Beal (1980), and Nickens and Associates (Reed and Tucker 1983) documented Tewa polished series, a variety of micaceous wares, and a small number of prehistoric types. More recently, Carrillo (1987b) has noted that, in addition to the Tewa wares, Historic Apachean and Hispanic wares are found on sites within the study area.

11.2 LABORATORY METHODS

The present collection of ceramics was visually sorted, and then each sherd was individually examined. It was clear that the sherds collected from most sites represented individual pot drops. It was therefore not necessary to examine the temper in all sherds. A small break was made on a random number of sherds, and the paste and temper were examined in order to establish a taxonomic description for the assemblage.

The ceramics analysis produced the following data. Table 11.2 lists each site and the associated types. A chronological position for each of the ceramic categories is also provided in the table.

Table 11.2 Ceramic Types and Dates, Abiquiu Archaeological Study, ACOE 1989.

LA No.	No. and Type Name	Chronological Position A.D.
51703	73 Chacon Micaceous	1830s-1870s
27020	60 Valdito Micaceous	1600 -1900
	3 Tewa Polished series	1600 -1900
25333	274 Powhoge Polychrome	1760 -1850
25532	20 Valdito Micaceous	1600 -1900
25480	16 Penasco Micaceous	1600 -1900
51698	1 Penasco Micaceous	1600 -1900
51701	1 Gallina Black-on-white	mid-1400s
51700	1 Corrugated Pueblo IV utility	late 1400s
	1 Unidentified black-on-white	?
	20 Chacon Micaceous	1830s-1870s

11.3 DISCUSSION

One of the most perplexing problems for ceramic studies in the Abiquiu Reservoir area relates to the various micaceous wares. Previous researchers have commented about assigning a taxonomic category to these wares. The problem is best exemplified by the following comments concerning 1976 work at the reservoir.

> An unexpected result of the analysis of ceramics from the excavations was the determination that the micaceous pottery which we found on survey and occurred significantly in the excavated features was in all probability trade ware from Picuris (or possibly Taos) Pueblo. It was earlier suggested that this pottery might be the same as or closely related to Ocate Micaceous, the diagnostic Jicarilla pottery from the east side of the Sangre de Cristos (Schaafsma 1975a; Gunnerson 1969). However, comparison of the specimens of micaceous culinary pottery from Picuris shows the present collection to be virtually identical with the sherds from that pueblo. If there are sherds of Apache pottery in the present collection, they would have to be discriminated on other bases than visual inspection with a hand lens. Personally I wonder if Ocate Micaceous can be separated from Penasco micaceous if only sherds are examined (Schaafsma 1978b).

Although ceramic data from well-documented and dated sites in the Abiquiu area are generally lacking, available survey and excavation data suggest that two distinct time periods are represented by the numerous micaceous wares. The first period consists of Piedra Lumbre sites, which have now been assigned to a Tewa occupation and date from 1630 to 1740 (Kemrer 1987). The micaceous ceramics associated with these sites are a thin-walled type with a micaceous paste, identified as Penasco Micaceous, and a second type characterized by the use of a micaceous slip and a sand-tempered paste, known as Valdito Micaceous slip. The second time period is represented by historic sites that date from 1750 to 1900 and contain a thin Ocate or Ocate-like ware; a thicker micaceous ware made by Jicarillas and known as Cimarron Micaceous; Petaca Micaceous, a Hispanic ware similar to Penasco Micaceous in all aspects except for the presence of feldspar; El Rito Micaceous, a slipped ware produced by Hispanics in the tradition of the earlier Valdito ware; and an unnamed micaceous ware that is probably attributable to nineteenth century Jicarilla potters.

While the micaceous ceramics from the first time period were probably produced by Tiwa or Tewa occupants who utilized the Abiquiu region as shepherds, the second group of ceramics was made by a variety of ethnic groups, including Genizaros, Hispanics, and Jicarilla Apaches.

A hiatus exists between the two time periods of 1600-1695 and 1750-1890. While it is entirely possible that this hiatus has been artificially created because of present chronometric procedures, there is a clear distinction between the two time periods. This distinction may in fact be related to the ethnic makeup of the site inhabitants and is important in understanding the historic use of the Abiquiu Reservoir area.

It is difficult to distinguish between the thin-walled Ocate wares and the Penasco wares because they are similar in color and finish. This similarity may relate to the proximity of the eighteenth century Jicarillas and the inhabitants of Picuris, as they probably used clay sources from the same geological formations.

Dick (1965b:144) reports that Penasco Micaceous bowl rims usually have parallel sides with rounded lips and olla rims have everted rims. Dick (1965b) describes the temper of Valdito micaceous ware as containing some variant of coarse quartzitic and arkosic sand and mica. Research indicates that Picuris wares usually contain feldspar. In most cases the local Valdito ceramics recovered from the Abiquiu Reservoir lack feldspar and contain a quartz sand temper. It is likely, therefore, that the Valdito wares were manufactured at one or more of the local Tewa pueblos (Beal 1980, Carrillo 1987b, Schaafsma 1975a). In almost all cases noted by previous research, Penasco Micaceous and Valdito Micaceous are associated with Tewa Polished wares (Tewa Red-on-buff, Kapo Black, and Tewa Buff).

Based on this cursory information, it is postulated that sites containing either Penasco or Valdito Micaceous wares can be dated to a period predating the second colonial period of 1692. It is further suggested that sites containing these micaceous wares were occupied by Tewa pastoralists from nearby Tewa villages.

The micaceous assemblages of the second time period (1750-1900) are more complex than those of the first period and relate to technology and cultural affiliations. At least two cultural groups (Apaches and Hispanics) are represented in the second time period. The Genizaros of Abiquiu are culturally Hispanic and are included in this group.

Excavation data from LA 6602 (the Spanish colonial site of Santa Rosa de Lima [Carrillo 1980] near the present village of Abiquiu) and LA 25326 (the Pedro Ignacio Gallego mill site on Seco Wash [Carrillo 1987b]) indicate that micaceous wares were commonly traded and probably manufactured by local Hispanics. These wares include the locally produced El Rito Micaceous Slip and Petaca Micaceous as well as the Jicarilla, Ocate, and Cimarron Micaceous wares. In addition to these wares, an unnamed micaceous ware has been found at the excavated sites mentioned above.

Ethnohistoric information indicates that Hispanic or Hispanicized women were actively engaged in the manufacture of ceramic containers until the early 1940s.

The main characteristics of Jicarilla wares, especially the Cimarron Micaceous wares, are a squared or flattened lip and a rim that tends to thicken and flare toward the lip. The Cimarron wares differ from the Ocate materials by having thickened walls and the presence of a slip or floated mica layer on the exterior surface. Numerous examples are documented from sites throughout the region. Gunnerson (1979) dates these wares from 1750 to 1900. A previously undescribed micaceous ware has now been documented for at least three sites in the Abiquiu Reservoir area, as well as the site of Santa Rosa de Lima de Abiquiu, two miles downstream from the present village of Abiquiu. The sites are LA 25326, the Gallego mill site; LA 51703, a lithic scatter site; LA 51700, a lithic scatter site; and LA 6602, the eighteenth century mission site.

The undescribed ware was manufactured from a crushed micaceous schist and very much resembles Cimarron Micaceous ware, as it even bears a micaceous slip or float. This may in fact be the same type of ware that Gunnerson (1979) refers to when he describes the John Alden site, which dates to the 1850s.

> The dominant pottery of the site, a previously unreported type, is undecorated and tempered with crushed mica schist. It is like Cimarron Micaceous except it is not made from micaceous clay. Associated with this pottery, almost certainly of Apache manufacture, were sherds of Powhoge Polychrome from Nambe Pueblo dated at 1760-1850. Also of interest for dating is a U.S. Dragoon uniform button of a type made only from 1840 until 1849, that probably did not arrive in New Mexico before 1846, when the U.S. Army took over (Gunnerson 1979:168).

Historic data indicate that the Jicarilla were already living in the Rio Grande Valley by at least 1750. From other historical accounts it is known that the Jicarilla were manufacturing ceramics as late as the 1870s.

The presently available data suggest that members of the Chacon branch manufactured the unnamed wares. While the research is far from complete, it is hoped that the data offered below will explicate the problem of mid-nineteenth century Jicarilla ceramic traditions. Tracing the movements of one of the Jicarilla bands (known as Olleros) from 1849 to 1870 is difficult; however, the following references to the Jicarillas and more specifically to Chacon's group should shed some light on the subject. It should be noted that the Jicarilla were relatively mobile, based on the ethnohistoric data.

On May 30, 1849, Jicarilla Apaches camped at the headwaters of the Rio de los Osos and attacked Abiquiu (Appendix to Brief of a Petitioner Jicarilla Apache Tribe -vs- the United States of America, Docket No. 22-A Indian Claims Commission). That same year Sergeant James Bally met with Chief Chacon and Chief Flechas Rayada near the Hispanic settlement of Santa Barbara approximately 25 miles south of Taos. Two years later Chacon, along with a confederation of other Jicarilla chiefs, concluded a treaty for the Jicarillas east of the Rio Grande. Sometime in the spring of 1851, Lieutenant James N. Ward, who was assigned to inspect the Pecos Valley, met with Chief Chacon and questioned him concerning the breaking of the earlier treaty. Chacon replied, "I and my family are starving to death, we have made peace, we do not want to do harm -- as you see from our bringing women and children with us. We want to go to the clay bank at San Jose [on the Pecos River 72 miles southeast of Abiquiu] and make vessels to sell so as to procure an honest living. We can't steal, and must do something to earn a living" (Bender 1974). Within a few days of Ward's visit, Lieutenant Chapman visited Chacon's camp about 15 miles east-southeast of San Miguel [on the Pecos River 75 miles southeast of Abiquiu] and found the chief with about 50 men, women, and children engaged in making pottery (Bender 1974:33).

Again in 1851, a reference is made to Chacon's group when Lieutenant Holiday wrote that he found about 200 Jicarillas, some 60 warriors under Chief Chacon, encamped near the Smoky Mountains (Sierra Oscura?) about 60 miles east and southeast of Manzano, a Hispanic settlement in the Manzano Mountains.

Two years later Governor and Superintendent of Indian Affairs Lane settled Chacon's group of Jicarillas on the Rio Puerco (this is the Rio Puerco of the north that empties into the Chama River near the present town of Youngsville). Sleck reported to Governor Lane (Bender 1974:440):

> after some persuasion their principal chief Chacon expressed a willingness to attempt the cultivation of the soil. We accordingly set out next day to select a suitable location, and after a careful examination of the country, west of the Rio de[l] Norte -- occupied by those Indians, we fixed upon lands lying upon the Rio Puerco a small stream that empties into the Chama twenty miles west of the town of Abiquiu....it is also the only place west of the Rio del Norte in the Jicarilla Country that can be obtained without encroaching upon the rights of other Indians, the Utahs refuse to let them locate farther north and the Navajos to let them be established further south and west.

In the spring of 1854, Lieutenant Colonel Cook defeated a group of Jicarilla under Chief Chacon near Ojo Caliente, New Mexico, and the band fled to Canjilon, New Mexico, an area north of the present reservoir at Abiquiu.

By the fall of that same year, General Garland reported that the Jicarilla had more than 100 lodges above Abiquiu on the Chama River (Bender 1974:55). Historic documents relating to the settlement of Abiquiu and Canones (Carrillo 1987a) place the Jicarilla lodges near the northern edge of the Abiquiu Reservoir area.

It is not clear where the Ollero Jicarilla were between 1854 and 1856; however, in May 1856, Indian agent Labadi reported that the Jicarilla of his agency at Abiquiu were engaged in tilling the soil and making pottery (Bender 1974). In the fall of that same year, Governor Meriweather visited the Jicarilla "above Abiquiu on the Chama" (Bender 1974:95) and found them living peacefully.

A constant flow of Jicarilla apparently continued to arrive in Abiquiu. Chief Chacon died sometime in 1855, and Chief Negro succeeded him. From 1856 to 1862, tensions mounted as attempts to place the Jicarilla on a permanent reservation met with failure. The Civil War disrupted plans to settle the Jicarilla. Newcomers in the areas around the Cimarron agency intensified tensions and strained natural resources, preventing the Jicarillas' traditional use of already limited resources. Historical documents are unclear about the Ollero Jicarilla around the Abiquiu agency. Apparently, many had intermarried with local Hispanics.

In 1867, it was reported that

> a short distance from this agency [Abiquiu?] there is now one locality near the La Quava [La Cueva] 22 of this band, which number 110 Indians, and a short distance from there, are 12 lodges more, which number about 60. The two parties have planted corn where they are located and depend upon this agency for subsistence till it is grown. The two bands of Jicarilla Apache express a wish to remain in this country, as it is near where they can obtain the best clay for the manufacture of pottery (Bender 1974:231).

Inspector Thomas V. Kerns wrote to Assistant Inspector General Nelson H. Davis that the Jicarilla on the west side of the Rio Grande (presumably those around the Abiquiu agency area) were more industrious than other bands and Utes because they cultivated fields and their women made ollas, which they extensively traded to "Mexicans" (Hispanics) (Bender 1974:34).

A lack of unification among the Jicarilla leaders of Abiquiu and Cimarron led to continued problems. In 1869, the Maxwell Land Grant began restricting Jicarilla access to natural resources within its boundaries. Mining activities and the lack of a permanent home brought about the near annihilation of the Jicarilla, who were finally removed from the Abiquiu area in 1883.

> Considering (1) the presence of a majority ware closely resembling Jicarilla Apache pottery found elsewhere; (2) the presence of trade pottery from Nambe, a Pueblo with which the Jicarilla had much contact (Bandelier 1890:261); (3) the date of about 1850, and the site location near the town of San Miguel, there is little doubt that it can be attributed to the Jicarilla band that James C. Calhoun (Bender 1974:350) said was in the specific area in 1851 under the leadership of Chief Chacon (Gunnerson 1979:168).

The preceding review of Jicarilla history -- as it relates to the Abiquiu area -- shows that the Jicarilla were actively making pottery from the 1840s until the 1880s. More specifically, it is clear that the traditional clay sources in the Sangre de Cristo Range were utilized throughout a period from the mid-1700s until the mid-1800s, when land grant changes, Hispanic village expansion, and later Anglo mining activities restricted access to traditional clay sources. What is not clear is the source of material (micaceous schist) used in the manufacture of pottery found at both the John Alden Site near San Miguel and the sites in the Abiquiu region.

Based upon this information the tentative name of Chacon Micaceous is suggested for the unnamed ware found at LA 51700 and LA 51703. The name is that of the Jicarilla Chief who occupied both areas within his lifetime. It is likely that women with the Chacon band manufactured the micaceous ceramics using a different material source from that used by their cousins at the Cimarron agency.

Detailed petrographic analysis is necessary to establish this type. Complicating the matter is the fact that Hispanic women (or Hispanicized women) in Hispanic villages began making their own micaceous wares during this same time period. How similar these wares are awaits a thorough study. Meanwhile, future research in the Abiquiu Reservoir study area should take note of the two ceramic periods and the micaceous traditions associated with these periods.

CHAPTER 12.0 SUMMARY OF ABIQUIU RESERVOIR OCCUPATIONS

Amy C. Earls

This chapter summarizes patterning of occupation intensity for each major time period or phase. The presentation is aimed at determining land use for various time periods and broad patterns of land use in the project area. Data bases discussed are numbers of obsidian dates per period for each site cluster (Llano Piedra Lumbre, Comanche Canyon, Arroyo del Chamiso, Arroyo de Comales) and proximity to the river for the site clusters. Also considered are site size and the nature of the artifact assemblage.

12.1 DISTANCE TO RIO CHAMA AND SITE SIZE

The five site clusters differ considerably in distance from the Rio Chama and in site size. Mean values are given in Table 12.1.

Table 12.1 Mean Distance from Rio Chama and Site Size, Abiquiu Archaeological Study, ACOE, 1989.

Site Cluster	Distance (m)	Site Size (m^2)
Llano Piedra Lumbre	1,788	7,950
Comanche Canyon	1,471	16,840
Arroyo del Chamiso	425	1,750
Arroyo de Comales	560	2,003
Canada de Chama[1]	80	435

1 Represented by one site.

Excluding the Canada de Chama "cluster", represented by only one site, the table shows a direct relationship between distance from the river and site size. The smaller sites tend to be closer to the river than the larger sites. The exception is the Llano Piedra Lumbre cluster, which averages 317 m farther from the river yet has a smaller mean site size than the Comanche Canyon cluster. The obsidian data have indicated that sites at Abiquiu Reservoir grow by accretion, that the assemblages consist of numerous occupations at different periods, and that these occupations are compounded to produce megasites and megasite clusters. The larger sites, which are also farthest from the river, are the most likely to contain many components. The explanation for this pattern may involve resource locations and travel routes.

Known important resources are water, firewood, and lithic sources. All of the locations are near at least seasonal (arroyo) water, and LA 51699 is adjacent to the Rio Chama. Correlating with water are tree locations; juniper and pinyon pine probably occurred along the river terrace and arroyo and

escarpment slopes during most occupations. The distinction between hardwoods and softwoods may have been of primary importance for utilization during the prehistoric, pre-metal axe period. Comanche Canyon is the best developed tributary drainage in the project area and has the largest sites; the canyon depth and shelter probably offered excellent softwood tree and water resources during much of the year for short- or long-term camping. The smaller Llano Piedra Lumbre sites, on the other hand, are situated along mesa slopes overlooking a shallower arroyo. The Arroyo del Chamiso and Arroyo de Comales sites are near the river terrace overlooking shallow tributary arroyos which would have contained fewer trees, although the terrace surface itself probably contained considerable juniper, with willow and cottonwood in the river floodplain. During prehistoric, pre-metal times, the river offered hardwood trees, such as cottonwood and willow, which would have been useful for construction but more difficult to cut and trim than the softwood pine and juniper available away from the river terrace.

Lithic resources in the project area are quite diverse owing to the fact that two major rivers, the Rio Chama and Rio Puerco, join in the area, so that the lithic debris of each is combined with gravels containing debris from ancestral rivers. Jemez obsidians occur in the vicinity of the Valle Grande of the Jemez Mountains and include the Cerro del Medio and Obsidian Ridge sources that are present in Canones and Abiquiu Creeks south of the project area. Polvadera obsidian occurs in outcrops along Polvadera Creek, approximately 9 km south of Abiquiu Dam, and Canones Creek, just below the dam. Pedernal cherts and chalcedonies occur on Cerro Pedernal slopes 11 km southwest of the dam. Within the project area, these cherts and chalcedonies occur throughout the Pleistocene terrace gravels and are mixed with alluvial debris from rivers ancestral to the Chama and Puerco (Whatley and Rancier 1986). While the obsidians do not occur in the immediate project vicinity, Pedernal chert is present along the Chama River terrace and in some tributary streams. Because of the generalized ubiquity of high-quality lithic resources in the project area, it is difficult to quantify distance to sources in examining settlement patterns. Other variables (wood, fauna, etc.) may have been equally as important as proximity to lithic resources in determining where materials were reduced and tools manufactured.

The Rio Chama was used as a travel corridor during historic and probably prehistoric times. The Llano Piedra Lumbre and Comanche Canyon areas on the north and east side of the river are situated just east of the confluence of the Rio Puerco and Rio Chama, along the route up the Arroyo Seco or across the Seco and westward to the upper Rio Chama and Rio Gallina.

12.2 DATES OF OCCUPATIONS

The 271 dated obsidian specimen dates are summarized by period for each site cluster in Table 12.2. These data indicate the following patterns. First, the En Medio Phase is the best represented occupation in the project area with 112 specimens. Other periods with significant occupations in the project area are the Early Developmental (89 specimens, 33 percent) and Late Developmental (33 specimens, 12 percent) Periods. Other periods with minor occupations are the Armijo Phase (10 specimens, four percent), Classic Period

(10 specimens, four percent), and Coalition Period (10 specimens, four percent).

Table 12.2 Number of Obsidian Dates Per Time Period for All Sites and for Four Site Clusters, Abiquiu Archaeological Study, ACOE, 1989.

Period	No. Obsidian Dates	Percent of Occupations	Llano Piedra Lumbre	Comanche Canyon	Arroyo del Chamiso	Arroyo de Comales
Historic	1	<1	--	--	--	2
Classic	10	4	1	3	--	11
Coalition	10	4	6	3	--	2
Late Devevelopmental	33	12	6	12	--	26
Early Devevelopmental	89	33	30	34	38	35
En Medio	112	41	49	42	63	24
Armijo	10	4	5	4	--	--
San Jose	3	1	1	1	--	--
Pre-PaleoIndian	3	1	--	1	--	1
Total	271	100	79	137	8	47

The En Medio Phase has the highest percentage of dates in the Llano Piedra Lumbre, Comanche Canyon, and Arroyo del Chamiso clusters. In the Arroyo de Comales site cluster the Early and Late Developmental Periods have higher percentages of specimens than the En Medio Phase. The Arroyo de Comales cluster is also unusual in showing a relatively high percentage of Classic Period dates (only five specimens, however) when compared with the other three site clusters. Also notable is the low percentage of Late Developmental Period specimens in the Llano Piedra Lumbre cluster.

Cross-dated point type time spans are generally too long, covering three to four periods or phases, to supplement the above patterns in a useful way, but the C-14 and ceramic data are useful in supplementing the obsidian data. The nine C-14 dates are distributed among the Historic (four dates), Coalition/Classic (one date), Late Developmental/Coalition (one date), and Developmental (one date) Periods, and San Jose/Armijo Phases (one date). All C-14 dates are from the Llano Piedra Lumbre and Comanche Canyon site clusters. Six of these were from Piedra Lumbre structures, one in each site cluster; the remainder were from two hearths on LA 51698 in the Llano Piedra Lumbre site cluster. All of the C-14 dates are from periods or phases with only minor occupations (less than four percent of the specimens) indicated by obsidian dates; the C-14 dates confirm that it is unwise to depend on obsidian dates alone. The Llano Piedra Lumbre site (LA 51698) has San Jose/Armijo Phase, Developmental, Late Developmental/Coalition, and two Historic Period dates. The Comanche Canyon site (LA 27020) has two Late Classic/Historic and one Historic Period dates.

The cross-dated ceramic time spans indicate Developmental through Historic Period occupations. Ceramics were recovered from all three site clusters except Arroyo del Chamiso. One type spans the Developmental through Classic Periods. Also present are Coalition and Classic types and numerous Historic Period types. The Llano Piedra Lumbre cluster contains two types of Historic ceramics and the Comanche Canyon cluster three Historic types. The Arroyo de Comales sites produced the Developmental through Classic, Coalition, and Classic types as well as three Historic types. As with the C-14 dates, the ceramic cross-dates indicate occupation in the later periods which produced fewer obsidian dates. Best documented by ceramics are the Historic Period occupations, which are present on sites from all three site clusters.

Thus, the evidence for occupational intensity during different time periods at these four site clusters (LA 51699 in the Canada del Chama has no associated dates) varies according to the dating method used. The obsidian dates document that obsidian reduction or use was greatest during the En Medio Phase through Late Developmental Period. The C-14 dates confirm Developmental Period use and also reflect considerable Historic Period use. The ceramic dates also indicate post-Developmental occupation, especially during the Historic Period. Two Piedra Lumbre structures are dated by C-14, ceramics, and architecture to the Piedra Lumbre Phase of the Historic Period. Other dated features are a basin-shaped hearth C-14 dated to the Developmental through Classic Periods and by historical sherd contents to the Historic Period and an eroded hearth dated to the San Jose/Armijo Phase.

12.3 ASSEMBLAGE CHARACTERISTICS

One variable by which assemblages can be contrasted is the ratio of biface flakes to tools; this ratio indicates proportion of manufacturing debris to finished tools on a site. Mean averages are 1.57 for Llano Piedra Lumbre sites, 1.35 for Arroyo de Comales sites, 9.09 for Comanche Canyon sites, and 4.26 for Arroyo del Chamiso sites. A variable which informs on intensity of tool discard is number of tools per square meter. The mean tools/m^2 for Llano Piedra Lumbre sites is 0.10, for Comanche Canyon sites is 0.12, for Arroyo del Chamiso sites is 0.02, and for Arroyo de Comales sites is 0.16.

The data from the cluster analysis on surface collection units (Chapter 9) show that there is a slight tendency for assemblages with low percentages of Pedernal chert (n=14, mean=1,275 m) to be farther from the Rio Chama than assemblages with high percentages of these materials (n=22, mean=1,136 m). When the site clusters are examined in terms of prevalence of Pedernal chert in site assemblages, the distributions are as follows. First, both Arroyo del Chamiso units are in the high Pedernal chert/high heat treatment cluster; this cluster has the shortest mean distance to the river (except for the single site "cluster" for LA 51699). The Arroyo del Chamiso sites are obsidian dated to the En Medio Phase and Early Developmental Period. The Llano Piedra Lumbre and Arroyo de Comales sites show the greatest variability in Pedernal chert and heat treatment percentages, with units from each locational cluster occurring in three different analytical clusters. The Llano Piedra Lumbre cluster has six units exhibiting high Pedernal chert and high heat treatment, two with low Pedernal chert and high heat treatment, and two with low Pedernal chert

and low heat treatment. These sites are located farthest from the Rio Chama, averaging 1,788 m. Llano Piedra Lumbre occupation is predominantly during the En Medio Phase and succeeding Early Developmental Period, the same as for the Arroyo del Chamiso sites. The Arroyo de Comales sites show seven units with high Pedernal chert and high heat treatment, three units with low Pedernal chert and high heat treatment, and one unit with high Pedernal chert and low heat treatment. These sites average 560 m from the Rio Chama, second to the Arroyo del Chamiso sites. The Arroyo de Comales sites date on the average later than the other site clusters, with most apparent occupation during the Early Developmental Period, followed by the Late Developmental Period and the En Medio Phase.

The Comanche Canyon sites, the largest in the project area, show less variability on the Pedernal chert and heat treatment variables than do the Llano Piedra Lumbre and Arroyo de Comales sites. The Comanche Canyon sites occur in only two clusters, high Pedernal chert and high heat treatment (five units) and low Pedernal chert and high heat treatment (seven units). The Comanche Canyon sites are second to the Llano Piedra Lumbre sites in distance from the river; the sites date primarily to the En Medio Phase and Early Developmental Period. It appears that distance from the river, which may equate to distance from Pedernal chert outcrops, explains some but not all of the variability in percentage of Pedernal chert and heat treatment on project area sites.

In summary, distance from the Rio Chama is directly correlated with site size except that the largest sites, those in Comanche Canyon, are closer to the river than the Llano Piedra Lumbre site cluster. The pattern may be due to the distribution of resources, water, firewood, and lithic sources that occurred all along the Rio Chama and perhaps in nearly as great abundance in the largest project area tributary, Comanche Canyon. The largest sites are also along a possible travel route from the Rio Chama and Rio Puerco confluence and up the Arroyo Seco to the upper Rio Chama and Rio Gallina drainages. Obsidian dates show that greatest overall occupation of project area sites occurred during the En Medio Phase, followed by the Early and Late Development Periods. Much of the intense En Medio occupation took place in the Llano Piedra Lumbre, Comanche Canyon, and Arroyo del Chamiso site clusters. The Arroyo de Comales cluster is unusual in its evidence of more Developmental Period than En Medio Phase occupation. The nine radiocarbon dates for the project, seven of which are associated with Piedra Lumbre structures or historical ceramics, are generally from Anasazi or Historical time periods which were relatively infrequently associated with obsidian dates. As with the C-14 dates, ceramic cross-dates indicate post-Developmental occupation which produced relatively few obsidian dates.

Biface flake/tool ratios show that tool manufacturing was most intense for Comanche Canyon and Arroyo del Chamiso sites. Tool discard as indicated by mean number of tools per square meter was most intense at Arrovo de Comales, Comanche Canyon, and Llano Piedra Lumbre sites, and very infrequent at Arroyo del Chamiso sites.

Based on the K-means cluster analysis on heat treatment and Pedernal chert prevalence, the two Arroyo del Chamiso units, both with high frequency

of heat treatment and Pedernal chert, and obsidian dated to the En Medio Phase and Early Developmental Period, comprise the site cluster closest to the Rio Chama. The two site clusters with greatest variability in heat treatment and Pedernal chert are the farthest from (Llano Piedra Lumbre) and second closest to (Arroyo de Comales) the Rio Chama. The Llano Piedra Lumbre sites are obsidian dated with greatest frequency to the En Medio Phase and Early Developmental Period, while the Arroyo de Comales sites contain obsidian that tends to date later, to the Developmental Periods followed by the En Medio Phase. The Comanche Canyon sites are intermediate in assemblage variability based on the K-means analysis and in distance to the Rio Chama; they date to the En Medio Phase and Early Developmental Period. The Arroyo de Comales sites are variable from other clusters in occupation period and assemblage characteristics, but this difference cannot be tied directly to distance from the Rio Chama.

13.0 CONCLUSIONS AND RECOMMENDATIONS

Amy C. Earls with John C. Acklen

Analysis of archaeological assemblages recovered at Abiquiu Reservoir focused on several specific topics originally discussed in Chapter 3. These can be summarized as follows:

- intensive study of subassemblages apparently resulting fr... a single cultural event based on lithic material type and reduction stage;
- consideration of the role of postdepositional processes on obsidian hydration rates in order to assess the value of such analyses for absolute chronometry and for intrasite relative chronometry;
- chronometric evaluation of obsidian debitage and formal tools;
- typological assessment of chronologically and typologically anomalous Archaic projectiles and ceramic assemblages; and
- site taphonomy and its role in modifying spatial patterns observed in the archaeological record.

An attempt was made to isolate culturally synchronous subassemblages during initial lithic analysis. Subassemblages were defined on the basis of artifact densities and material type within surface collection units. The resulting proveniences were subsequently described and compared using the results of rough sort and detailed lithic analyses presented in Chapter 6.

13.1 CONCLUSIONS

Although variability was detected among sites and between proveniences, overall patterning was not clear-cut. In several instances, those subassemblages which were isolated did appear to reflect isolated occupations. For example, at LA 25328 four discrete components were posited on the basis of interprovenience technological similarities. One of the components, a lithic cache designated Provenience 12, was of particular interest in that it demonstrated the intent to store usable, specially prepared lithics on the part of the occupants in anticipation of returning to the exact location at a future time.

In a more general sense, however, the picture that emerged from technological analysis was of a blurred, generalized scatter reflecting thousands of superimposed activities. Such a pattern appears to reflect the random spacing of thousands of short-term events over millennia in a favored locale. Detailed analytic techniques were no more successful in delineating discrete occupations than were rough sort techniques. Obsidian chronometric studies presented in Chapters 7 and 8 suggest that, with the exception of the cache at LA 25328, even the posited discrete components isolated during technological analysis were not discrete. In a general sense, technological and material

selection homogeneity analysis does not appear useful in isolating discrete components in a multiple occupational situation.

Obsidian studies presented in Chapters 7 and 8 did demonstrate that postdepositional processes have a significant effect on rind thickness and the chronological implications thus derived. The most significant factor is variability in temperature resulting from differences in solar exposure, slope aspect, depth of burial, and rind attrition. Of special interest is the power function relationship between temperature and hydration rate which indicates that even short-term thermal exposure of obsidian to a roasting feature or forest fire will greatly increase the apparent age of the artifact. In like manner, soil abrasion in the form of sandblasting may reduce the thickness of an obsidian rind thereby resulting in the underestimation of the item's age. Such studies invoke caution in the age attributable to a single artifact suggesting that clusters of obsidian are more appropriate units of analysis. For example, Chapter 7 analysis (section 7.5.9) suggested that obsidian from the northern portion of the collection unit on LA 27041 exhibited slower rind development and "too recent" dates due to factors tending to inhibit rind development, including cooler temperatures and greater erosion. Obsidian from the southern part of the site, on the other hand, showed faster hydration due to warmer temperatures and less erosion. Such studies also indicate that multiple, precisely located cuts on a single item may be expected to produce a relatively reliable absolute date on specific obsidian items.

The chronometric evaluation of obsidian debitage and formal tools presented in Chapter 7 focused on the same provenience units isolated during lithic analysis presented in Chapter 6. Results indicate that traditional lithic analytic approaches designed to isolate spatiotemporal clusters are not effective, at least at Abiquiu Reservoir. Studies present a glaring result with far-reaching implications; obviously intact, purportedly single-function loci are not the result of a single cultural event. For example, at LA 27042, a spatially discrete, uneroded, technologically homogeneous, pure obsidian assemblage exhibited the same range of dates as did the site and project area as a whole! Conversely, an obviously disarticulated, sheet washed assemblage at LA 27018 retained considerable spatiotemporal coherence. The conclusion reached on the basis of chronometric analysis of obsidian underscores and strengthens the pattern of multicomponency identified during the technological analysis presented in Chapter 6.

Sites at Abiquiu Reservoir are not the result of a discrete set of cultural events; rather, they are an accumulation of a multitude of short-term events conducted over a long period of time. Such patterns necessarily call into question the utility of the site as an appropriate unit of analysis in certain situations, more particularly, in favored, redundantly used locations. Depending upon research objectives, more appropriate analytical units might include synchronous spatial clusters such as those defined during multistage, multivariate, obsidian based analyses presented in Chapter 7, or alternatively, superclusters of sites stratified by geographic proximity as in Chapter 12. The former analytical units are suitable for behavior-specific research; the latter superclusters are amenable to a regionally based study of settlement and subsistence.

Another important conclusion derived from the chronometric studies is that, at least at Abiquiu, absolute dates recovered from projectiles may not be confidently assumed to correlate with production dates derived from spatially associated debitage. Reasons for the lack of association may include reuse, recycling, poorly dated diagnostics, and a poor understanding of technological adaptation.

One of the stated purposes of the current research project was to refine existing projectile point chronologies in the area, especially the Oshara Tradition as defined by Irwin-Williams (1973). Obsidian point dates for specific point types are correlated with published date ranges in Chapter 8. Results (section 8.3.3) show that Anderson's (1985) western Plains sequence was correct for 83 percent of obsidian specimens, Lord and Cella's (1986) Abiquiu Reservoir classification was correct for 70 percent, Thoms' (1977) northern Rio Grande sequence was correct for 59 percent, and Irwin-Williams' (1973) Oshara sequence was correct for 50 percent. Although the concurrence for individual typologies was low, particularly for the Oshara Tradition, only eight percent of the specimens produced obsidian dates outside the range of all classifications. This study suggests that Oshara Tradition phase estimates are inaccurate in general or inapplicable to the Abiquiu area or that Oshara points were used much longer than indicated by the Oshara phases.

The point chronology evaluation using dated obsidian (section 8.3) suggests a number of patterns. First, the few dated arrow points indicate that corner-notched arrow points were in use at Abiquiu by at least the A.D. 700s. En Medio-style points co-occur with arrow points into the Late Developmental/early Coalition Periods. Bertram's (1987) observation that stemmed point and Osharan point forms exhibit great stability through time in both size and form is partially confirmed. The present study did not confirm that San Jose points persist into Middle Coalition times, but did indicate that Armijo/En Medio forms were made into the Developmental Period. Given problems with cross-dating points based exclusively on Oshara types, continued obsidian hydration studies and greater focus on description of base morphology offer the best potential for developing a north central New Mexico chronology.

A similar situation is presented by ceramic data recovered from Abiquiu Reservoir. Although obsidian chronometric analysis suggests numerous occupations in the area in Pueblo I through Pueblo IV times, few ceramic artifacts from these times were recovered. The implication is that the adaptation to this particular environment during these times did not require the use of ceramics. It may be that early Anasazi occupants of the area behaved as did their earlier Archaic counterparts in an adaptation which favored the use of large projectiles, not pottery. Ceramic studies presented in Chapter 11 also underscore the relevance ethnographic data may possess for the archaeological interpretation of discrete sites.

A final research question addressed the role of site taphonomy in modifying spatial patterning observed in the archaeological record. This study demonstrated such movement and presents a cautionary tale to those who uncritically assume that artifact concentrations necessarily reflect activity areas. The archaeological assemblages in the vicinity of Abiquiu Reservoir are truly unique resources in that the obsidian can be dated. The present

study attempts to evaluate traditional analytical techniques for isolating spatiotemporal events in prehistory, the effect of postdepositional processes in altering individual artifacts and assemblages, the traditional site definition, and the role of diagnostics and their association with assemblages. The potential of obsidian-rich surface assemblage analysis for addressing middle range theoretical problems such as artifact movement through erosion is at present virtually unlimited.

The archaeological assemblages in the Abiquiu area are fascinating in that much sought after resources such as high-quality lithic sources and large game were locally available and were commonly used by prehistoric occupants all over the Southwest. This is reflected in the occurrence of Jemez obsidian in archaeological deposits located hundreds of miles away in any given direction. In that sense, the Abiquiu area is analogous to a magnet.

13.2 RECOMMENDATIONS

With the exception of LA 51699, all sites investigated retain considerable research potential in that obsidian is amenable to obsidian hydration analysis and absolute dating techniques. Site-by-site recommendations for further work are presented within the site descriptions.

The results of the MAI Abiquiu study suggest that the appropriate technique for collecting and analyzing lithic sites involves an obsidian sampling design. The obsidian hydration study indicated that there are probably few discrete, temporally coherent sites at Abiquiu. Instead, the homogeneity of the 9-15 occupations identified by the nonobsidian material type/reduction sequence analysis is inconsistent with the obsidian analysis, which suggested many occupations. The few artifacts resulting from each visit do not justify treating each more or less discrete site or homogeneous concentration as an analytical unit. It may be that obsidian cluster-based units are analytically redundant and can be grouped at some point, but this cannot be known until they are analyzed separately according to temporally meaningful criteria provided by obsidian hydration analysis.

The Abiquiu study shows that surface sites have tremendous research potential. Data can potentially be recovered economically without excavation even on sites that have experienced wave action or other major disturbance. Even in disturbed or deflated sites, perhaps 99 percent of useful archaeological data remains when obsidian-based research potential is considered.

Hydration and cross-dated low density obsidian clusters selected from locations varying in slope, exposure, and associated temporally diagnostic artifacts should be studied intensively to broaden methodological knowledge of factors such as temperature differential and erosion on lithic assemblages. Assemblages associated with features such as Piedra Lumbre structures or cobble rings and with dateable features such as hearths should be studied selectively. Samples should be chosen from assemblages with point, ceramic, and other artifact cross-dates and with good radiocarbon and archaeomagnetic potential so that cross-dates can be used to further refine the obsidian hydration rates. Low density obsidian clusters containing temporally diagnos-

tic artifacts or associated with dateable features would be preferable to high density clusters which should be suspected as multicomponent.

For the time being, no recommendations are made concerning nonobsidian artifacts; their patterning relative to obsidian should be monitored until nonobsidian can be dated directly. No more funds should be spent on intensive analysis of nonobsidian debitage where an obsidian alternative is present.

Emphasis should be placed on multistage collection of large sites, with the collection strategy biased toward obtaining obsidian-based spatiotemporal clusters. The initial obsidian hydration results would then be used to structure the second stage of site sampling. Stratification of samples would be based on spatiotemporal obsidian clusters identified in the first stage.

This study has shown that surface obsidian density of perhaps one item/10 m^2 confers research potential to a site regardless of other factors. This criterion makes most sites in the MAI and Abiquiu studies potentially significant. Current thinking about research potential and significance for the National Register of Historic Places needs to be reconsidered in light of the results reported in this study.

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APPENDIX A

OBSIDIAN SOURCING REPORT

By

Richard E. Hughes

Sonoma State University Academic Foundation, Inc.

ANTHROPOLOGICAL STUDIES CENTER
CULTURAL RESOURCES FACILITY
707 664-2381

September 5, 1986

Dr. Christopher M. Stevenson
Cultural Resources Management Division
Box 3BV
New Mexico State University
Las Cruces, New Mexico 88003

Dear Chris:

Enclosed please find xerox copies of fifteen summary sheets presenting x-ray fluorescence data generated from the analysis of 248 artifacts from the Abiquiu Dam project, central New Mexico. The artifact analyses were conducted pursuant to your letter request of August 6, 1986, under the terms of New Mexico State University Purchase Order A03736-M (Open Order), Sonoma State University Academic Foundation, Inc. Account 6081, Job X86-30.

Laboratory analyses were performed on a Spectrace™ 5000 (Tracor X-ray) energy dispersive x-ray fluorescence spectrometer equipped with a Rh x-ray tube, a 50 kV x-ray generator, 1251 pulse processor (amplifier), 1236 bias/protection module, a 100 mHz analog to digital converter (ADC) with automated energy calibration, and a Si(Li) solid state detector with 150 eV resolution (FWHM) at 5.9 keV in a 30 mm^2 area. The x-ray tube was operated at 30.0 kV, .30 mA, using a .127 mm Rh primary beam filter in an air path at 200 seconds livetime. Data processing is controlled by a Hewlett Packard Vectra™ microcomputer with 640K RAM memory; operating software and analytical results are stored on a Hewlett Packard 20 megabyte fixed disk. Trace element concentrations were computed from a least-squares linear calibration curve (see Hughes 1986: 37) established from analysis of 22 U.S. Geological Survey, French, and Canadian international rock standards. All trace element values on the enclosed summary sheets are expressed in quantitative units (i.e. parts per

1801 East Cotati Avenue Rohnert Park, California 94928

million [ppm] by weight), and these were compared directly to values for known obsidian sources that appear in Baugh and Nelson (1984), Hughes (unpublished data), Jack (1971), Nelson (1984: 52), and Newman and Nielsen (1985).

Artifacts were matched to the profiles of known geochemical types of obsidian on the basis of correspondences in diagnostic trace element concentration values (i.e., ppm values for Rb, Sr, Y, Zr, and Nb). Observed correspondences indicate that 24 specimens (Cat. nos. 86-319 through -322, -324, -342, -696, -718, -721, -732, -737, -741, -750, -780, -809, -815, -828, -832, -850, -853, -861, -863, -865, and -868) match the trace element signature of Cerro del Medio obsidian, and four artifacts (Cat. nos. 86-775, -836, -842, and -854) correspond with the fingerprint of Obsidian Ridge volcanic glass. The remaining 220 specimens (89% of the sample analyzed) were fashioned from obsidian of the Polvadera Peak geochemical type.

I hope this information will help in your analysis of these site materials. The artifacts have been returned to you under separate cover.

Sincerely,

Richard Hughes

Richard E. Hughes, Ph.D.
Senior Research Archaeologist

September 4, 1986

Abiquiu Dam, New Mexico

Specimen Number	Trace Element Concentrations Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-288	37.3 ±10.9	14.3 ±5.8	150.4 ±6.7	1.2 ±4.6	23.8 ±2.5	69.8 ±5.9	40.4 ±3.9	POLVADERA PEAK
86-289	44.9 ±9.7	14.5 ±5.8	155.9 ±6.8	7.0 ±4.6	24.2 ±2.6	73.9 ±6.0	47.3 ±4.0	POLVADERA PEAK
86-290	62.6 ±15.3	17.3 ±8.5	153.2 ±8.1	0.0 ±4.6	20.1 ±4.0	69.1 ±6.8	42.1 ±5.1	POLVADERA PEAK
86-291	50.3 ±10.8	17.2 ±6.3	149.5 ±7.1	3.4 ±4.6	24.2 ±2.9	66.8 ±6.2	41.9 ±4.3	POLVADERA PEAK
86-292	67.5 ±9.6	20.2 ±5.9	152.6 ±7.0	3.5 ±4.6	19.5 ±3.0	69.4 ±6.2	39.7 ±4.3	POLVADERA PEAK
86-293	54.2 ±8.5	14.6 ±5.6	151.6 ±6.8	1.7 ±4.6	22.5 ±2.7	74.1 ±6.0	45.0 ±4.0	POLVADERA PEAK
86-294	52.0 ±8.5	19.4 ±5.1	145.2 ±6.7	6.2 ±4.6	24.7 ±2.6	75.1 ±6.0	38.6 ±4.0	POLVADERA PEAK
86-295	51.3 ±11.4	14.7 ±6.8	150.3 ±7.2	0.0 ±4.7	19.1 ±3.2	64.5 ±6.3	40.9 ±4.4	POLVADERA PEAK
86-296	54.4 ±11.3	27.6 ±6.0	137.1 ±7.3	3.2 ±4.7	26.1 ±3.1	78.2 ±6.4	31.6 ±4.5	POLVADERA PEAK
86-297	52.4 ±11.3	22.6 ±6.0	149.0 ±7.3	1.2 ±4.6	18.4 ±3.4	64.3 ±6.4	39.8 ±4.5	POLVADERA PEAK
86-298	56.0 ±12.4	20.4 ±7.0	152.3 ±7.6	2.7 ±4.6	19.5 ±3.6	70.1 ±6.5	37.2 ±4.7	POLVADERA PEAK
86-299	44.9 ±10.3	17.4 ±5.9	167.6 ±7.1	1.7 ±4.6	26.5 ±2.8	73.0 ±6.1	43.7 ±4.2	POLVADERA PEAK
86-300	59.4 ±12.5	25.2 ±6.8	169.6 ±7.8	1.8 4.6	24.4 ±3.5	64.1 ±6.6	47.5 ±4.8	POLVADERA PEAK
86-301	49.3 ±9.9	23.0 ±5.4	152.2 ±7.0	1.6 ±4.6	24.6 ±2.8	72.4 ±6.1	45.8 ±4.2	POLVADERA PEAK
86-302	49.2 ±11.3	21.0 ±6.0	168.6 ±7.4	5.0 ±4.7	24.3 ±3.1	74.3 ±6.3	45.8 ±4.5	POLVADERA PEAK
86-303	63.7 ±11.4	17.9 ±7.5	134.2 ±7.3	1.7 ±4.6	22.3 ±3.3	66.6 ±6.4	41.2 ±4.6	POLVADERA PEAK
86-304	38.2 ±10.4	19.0 ±4.9	148.4 ±6.7	1.9 ±4.6	23.8 ±2.6	75.4 ±6.0	41.8 ±4.0	POLVADERA PEAK

* All trace element values in parts per million (ppm).
± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Abiquiu Dam, New Mexico
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Trace Element Concentrations

Specimen Number	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-305	58.6 ±10.8	17.2 ±6.2	149.5 ±7.3	0.7 ±4.6	23.2 ±3.1	78.6 ±6.3	36.4 ±4.4	POLVADERA PEAK
86-306	46.5 ±9.8	13.1 ±6.1	147.2 ±6.9	3.0 ±4.6	22.6 ±2.7	72.6 ±6.1	41.4 ±4.1	POLVADERA PEAK
86-307	37.6 ±10.0	14.3 ±5.4	146.6 ±6.7	2.3 ±4.6	21.7 ±2.6	72.2 ±6.0	46.5 ±4.0	POLVADERA PEAK
86-308	48.0 ±9.6	14.2 ±5.9	160.9 ±7.0	0.0 ±4.6	23.0 ±2.8	74.9 ±6.1	40.1 ±4.2	POLVADERA PEAK
86-309	38.7 ±11.7	22.3 ±5.2	160.0 ±7.0	1.8 ±4.6	25.8 ±2.8	71.2 ±6.2	47.8 ±4.2	POLVADERA PEAK
86-310	51.9 ±17.2	18.8 ±8.0	190.1 ±8.8	4.2 ±4.8	26.4 ±4.0	72.5 ±7.0	36.6 ±5.4	POLVADERA PEAK
86-311	44.3 ±13.6	21.9 ±6.0	155.3 ±7.6	1.4 ±4.6	27.1 ±3.2	73.9 ±6.5	38.2 ±4.7	POLVADERA PEAK
86-312	40.7 ±21.8	18.6 ±9.8	152.5 ±8.8	0.0 ±4.6	23.7 ±4.3	70.6 ±7.2	42.9 ±5.7	POLVADERA PEAK
86-313	37.6 ±10.9	14.6 ±5.5	133.9 ±6.8	1.9 ±4.6	23.4 ±2.6	64.4 ±6.0	36.0 ±4.1	POLVADERA PEAK
86-314	35.3 ±16.0	24.1 ±5.9	164.9 ±7.7	4.8 ±4.7	21.7 ±3.4	77.5 ±6.5	42.1 ±4.7	POLVADERA PEAK
86-315	60.3 ±11.1	24.4 ±6.0	161.7 ±7.6	3.3 ±4.7	23.4 ±3.3	73.8 ±6.5	37.0 ±4.7	POLVADERA PEAK
86-316	58.9 ±9.1	23.3 ±5.3	168.8 ±7.1	6.8 ±4.7	20.0 ±3.0	75.3 ±6.2	43.1 ±4.2	POLVADERA PEAK
86-317	45.4 ±9.1	22.3 ±4.8	150.8 ±6.8	4.1 ±4.6	22.2 ±2.7	71.6 ±6.0	39.5 ±4.1	POLVADERA PEAK
86-318	58.8 ±14.1	22.1 ±7.3	142.7 ±8.0	0.7 ±4.6	22.5 ±3.8	67.5 ±6.8	40.8 ±5.1	POLVADERA PEAK
86-319	77.8 ±8.8	18.4 ±5.6	177.8 ±7.1	1.2 ±4.6	45.1 ±2.8	175.6 ±6.5	52.6 ±4.3	CERRO DEL MEDIO
86-320	60.5 ±9.6	26.9 ±5.1	163.4 ±7.1	4.5 ±4.6	40.2 ±2.8	162.5 ±6.5	44.9 ±4.3	CERRO DEL MEDIO
86-321	66.1 ±10.5	21.8 ±6.0	163.2 ±7.3	0.0 ±4.6	41.9 ±3.0	165.9 ±6.7	47.3 ±4.5	CERRO DEL MEDIO

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Specimen Number	Trace Element Concentrations							Obsidian Source
	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	
86-322	81.9 ±14.6	20.5 ±8.8	163.4 ±8.7	0.0 ±4.6	42.6 ±4.0	167.5 ±7.9	46.6 ±5.5	CERRO DEL MEDIO
86-323	52.1 ±12.5	15.2 ±7.5	163.0 ±7.7	4.4 ±4.7	20.7 ±3.6	72.6 ±6.5	39.8 ±4.7	POLVADERA PEAK
86-324	67.5 ±10.6	14.2 ±7.3	176.7 ±7.6	1.0 ±4.6	43.0 ±3.1	166.1 ±6.9	44.0 ±4.6	CERRO DEL MEDIO
86-325	39.4 ±12.2	17.5 ±5.9	151.5 ±7.2	2.9 ±4.6	22.8 ±3.0	73.8 ±6.2	39.5 ±4.4	POLVADERA PEAK
86-326	43.8 ±10.6	15.5 ±5.9	157.7 ±7.1	3.8 ±4.6	23.1 ±2.9	68.8 ±6.2	42.2 ±4.3	POLVADERA PEAK
86-327	56.2 ±11.6	11.2 ±9.2	180.8 ±7.7	2.2 ±4.6	26.8 ±3.3	79.0 ±6.5	47.7 ±4.6	POLVADERA PEAK
86-328	50.7 ±11.2	6.1 ±3.5	158.5 ±7.4	3.7 ±4.7	26.4 ±3.1	69.0 ±6.4	47.0 ±4.6	POLVADERA PEAK
86-329	58.4 ±9.6	18.6 ±5.7	168.7 ±7.1	1.3 ±4.6	23.3 ±2.9	71.7 ±6.2	44.9 ±4.3	POLVADERA PEAK
86-330	43.1 ±13.7	18.8 ±6.4	156.4 ±7.5	4.2 ±4.7	28.1 ±3.1	76.4 ±6.4	42.3 ±4.6	POLVADERA PEAK
86-331	35.0 ±12.5	15.0 ±5.8	158.9 ±7.1	2.8 ±4.6	24.3 ±2.9	76.7 ±6.2	43.8 ±4.3	POLVADERA PEAK
86-332	48.4 ±7.7	18.3 ±4.7	137.0 ±6.7	3.6 ±4.6	22.6 ±2.6	63.8 ±6.0	40.5 ±4.0	POLVADERA PEAK
86-333	43.8 ±11.0	17.0 ±6.1	152.6 ±7.1	2.3 ±4.6	25.3 ±2.9	75.7 ±6.2	45.1 ±4.3	POLVADERA PEAK
86-334	36.7 ±11.2	21.7 ±4.9	161.0 ±6.9	1.2 ±4.6	23.3 ±2.7	75.8 ±6.0	49.4 ±4.1	POLVADERA PEAK
86-335	58.9 ±8.0	19.1 ±4.9	165.8 ±6.9	1.8 ±4.6	22.7 ±2.7	69.3 ±6.1	42.2 ±4.1	POLVADERA PEAK
86-336	45.8 ±8.1	16.4 ±4.8	147.8 ±6.7	2.7 ±4.6	23.0 ±2.6	70.7 ±6.0	44.5 ±4.0	POLVADERA PEAK
86-337	57.7 ±9.1	17.7 ±5.5	174.7 ±7.3	1.6 ±4.6	22.1 ±3.1	75.6 ±6.2	39.6 ±4.4	POLVADERA PEAK
86-338	47.7 ±8.0	16.2 ±5.0	159.6 ±6.7	2.1 ±4.6	24.7 ±2.5	72.1 ±6.0	43.7 ±4.0	POLVADERA PEAK

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Abiquiu Dam, New Mexico

Trace Element Concentrations

Specimen Number	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-339	43.5 ±9.4	22.7 ±4.8	149.9 ±6.9	3.4 ±4.6	20.9 ±2.8	76.1 ±6.1	42.1 ±4.1	POLYADERA PEAK
86-340	54.1 ±13.5	22.2 ±6.8	151.4 ±8.1	8.2 ±4.8	17.1 ±4.2	66.3 ±6.7	43.5 ±5.0	POLYADERA PEAK
86-341	60.5 ±9.5	21.3 ±5.5	167.1 ±7.3	3.2 ±4.6	20.5 ±3.1	73.0 ±6.3	46.2 ±4.4	POLYADERA PEAK
86-342	69.9 ±9.7	25.2 ±5.5	183.4 ±7.4	0.5 ±4.6	41.0 ±3.0	172.1 ±6.7	55.3 ±4.4	CERRO DEL MEDIO
86-343	47.4 ±8.3	17.3 ±4.9	160.9 ±6.8	1.2 ±4.6	24.0 ±2.6	70.7 ±6.0	46.5 ±4.0	POLYADERA PEAK
86-344	39.8 ±9.2	16.6 ±5.1	140.2 ±6.8	2.0 ±4.6	24.5 ±2.6	68.8 ±6.0	38.3 ±4.1	POLYADERA PEAK
86-345	57.8 ±8.8	14.8 ±5.7	156.6 ±7.1	3.8 ±4.6	25.9 ±2.8	69.1 ±6.2	44.4 ±4.2	POLYADERA PEAK
86-346	45.4 ±8.1	21.0 ±4.5	152.8 ±6.7	2.0 ±4.6	25.3 ±2.5	74.3 ±6.0	41.6 ±4.0	POLYADERA PEAK
86-347	43.2 ±11.5	20.3 ±5.4	143.7 ±7.1	3.5 ±4.6	22.8 ±3.1	66.6 ±6.3	44.9 ±4.4	POLYADERA PEAK
86-348	52.2 ±9.2	11.2 ±7.5	144.8 ±7.1	2.2 ±4.6	18.7 ±3.1	69.0 ±6.2	43.9 ±4.3	POLYADERA PEAK
86-349	47.2 ±8.3	19.1 ±4.8	152.1 ±6.8	2.3 ±4.6	24.4 ±2.6	67.1 ±6.0	41.6 ±4.1	POLYADERA PEAK
86-350	47.5 ±10.9	18.0 ±5.9	161.4 ±7.2	1.2 ±4.6	26.5 ±2.9	75.2 ±6.2	49.9 ±4.3	POLYADERA PEAK
86-351	58.8 ±12.9	26.2 ±6.3	145.9 ±7.9	4.8 ±4.7	25.5 ±3.5	66.6 ±6.7	39.9 ±4.9	POLYADERA PEAK
86-352	49.2 ±10.6	24.7 ±5.2	159.7 ±7.3	3.0 ±4.6	24.3 ±3.1	70.0 ±6.3	42.6 ±4.4	POLYADERA PEAK
86-353	47.0 ±11.9	12.8 ±7.0	159.9 ±7.4	2.4 ±4.6	22.3 ±3.2	72.7 ±6.4	39.9 ±4.5	POLYADERA PEAK
86-354	38.7 ±10.7	15.8 ±5.3	164.2 ±6.9	0.0 ±4.6	19.5 ±2.9	74.3 ±6.1	39.4 ±4.1	POLYADERA PEAK
86-355	45.3 ±8.5	26.1 ±4.6	147.8 ±6.8	1.6 ±4.6	22.2 ±2.7	65.5 ±6.0	37.7 ±4.1	POLYADERA PEAK

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

Trace Element Concentrations

Specimen Number	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-356	46.6 ±8.1	8.5 ±8.3	153.1 ±6.7	4.6 ±4.6	24.3 ±2.6	72.3 ±6.0	42.6 ±4.0	POLVADERA PEAK
86-357	55.6 ±10.3	22.8 ±5.7	159.3 ±7.4	7.2 ±4.7	25.0 ±3.1	67.6 ±6.4	44.6 ±4.5	POLVADERA PEAK
86-358	42.1 ±11.6	15.6 ±6.1	155.5 ±7.2	2.4 ±4.6	21.8 ±3.1	72.1 ±6.3	48.0 ±4.4	POLVADERA PEAK
86-359	35.8 ±9.0	22.4 ±4.3	146.8 ±6.6	4.7 ±4.6	21.7 ±2.5	70.9 ±5.9	43.5 ±3.9	POLVADERA PEAK
86-360	62.2 ±10.3	15.4 ±6.5	155.2 ±7.6	2.1 ±4.6	21.2 ±3.5	63.0 ±6.5	39.9 ±4.7	POLVADERA PEAK
86-361	50.7 ±8.2	19.8 ±4.9	161.2 ±6.9	3.4 ±4.6	24.5 ±2.7	71.8 ±6.1	43.8 ±4.1	POLVADERA PEAK
86-362	69.5 ±10.2	22.5 ±6.1	164.3 ±7.7	2.7 ±4.7	22.6 ±3.5	79.3 ±6.5	46.8 ±4.8	POLVADERA PEAK
86-363	49.5 ±9.0	15.2 ±5.6	155.5 ±7.0	4.5 ±4.6	25.5 ±2.8	74.0 ±6.1	45.5 ±4.2	POLVADERA PEAK
86-364	45.0 ±10.8	15.8 ±6.0	140.0 ±7.1	3.7 ±4.6	21.7 3.0	63.4 ±6.2	46.0 ±4.3	POLVADERA PEAK
86-365	48.1 ±7.3	19.1 ±4.6	145.9 ±6.6	5.6 ±4.6	25.2 ±2.5	68.2 ±5.9	39.7 ±3.9	POLVADERA PEAK
86-366	47.0 ±7.5	15.8 ±4.7	156.2 ±6.6	3.4 ±4.6	23.0 ±2.5	70.5 ±5.9	42.4 ±3.9	POLVADERA PEAK
86-367	32.7 ±12.5	16.2 ±5.2	140.3 ±6.9	0.8 ±4.6	23.2 ±2.8	70.9 ±6.1	40.2 ±4.1	POLVADERA PEAK
86-368	37.9 ±9.3	21.3 ±4.5	149.9 ±6.7	2.4 ±4.6	25.5 ±2.5	75.8 ±6.0	42.5 ±4.0	POLVADERA PEAK
86-369	51.5 ±9.1	25.5 ±5.2	166.7 ±7.3	2.9 ±4.6	19.1 ±3.2	71.1 ±6.2	49.4 ±4.4	POLVADERA PEAK
86-370	51.8 ±11.1	10.7 ±8.7	155.2 ±7.5	3.3 ±4.7	23.5 ±3.3	70.9 ±6.5	33.3 ±4.6	POLVADERA PEAK
86-371	54.5 ±9.4	19.6 ±5.2	158.2 ±7.1	5.1 ±4.7	25.0 ±2.9	71.7 ±6.2	37.7 ±4.3	POLVADERA PEAK
86-372	50.8 ±8.5	17.0 ±5.1	157.7 ±6.9	2.6 ±4.6	24.4 ±2.7	68.0 ±6.0	43.7 ±4.1	POLVADERA PEAK

* All trace element values in parts per million (ppm).
± Counting error and fitting error uncertainty at 200 seconds livetime.

Specimen Number	Trace Element Concentrations							Obsidian Source
	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	
86-373	46.3 ±8.5	18.6 ±4.8	154.3 ±6.8	3.5 ±4.6	26.7 ±2.6	75.9 ±6.0	43.3 ±4.0	POLVADERA PEAK
86-374	50.3 ±9.6	24.5 ±5.1	164.5 ±7.1	0.6 ±4.6	27.2 ±2.8	72.1 ±6.2	48.7 ±4.3	POLVADERA PEAK
86-375	37.5 ±10.0	21.4 ±4.6	166.7 ±6.8	1.1 ±4.6	25.2 ±2.6	71.0 ±6.0	43.6 ±4.1	POLVADERA PEAK
86-376	43.3 ±11.3	17.9 ±5.4	145.8 ±7.4	2.5 ±4.6	23.9 ±3.1	73.0 ±6.3	43.1 ±4.5	POLVADERA PEAK
86-377	34.6 ±16.7	23.7 ±6.0	163.8 ±7.7	1.9 ±4.6	24.9 ±3.4	72.9 ±6.5	36.8 ±4.7	POLVADERA PEAK
86-378	41.1 ±12.9	19.1 ±6.0	159.3 ±7.4	0.7 ±4.6	22.3 ±3.2	71.3 ±6.4	44.5 ±4.5	POLVADERA PEAK
86-673	48.0 ±8.5	19.2 ±4.9	150.1 ±6.8	0.0 ±4.7	25.7 ±2.6	71.7 ±6.0	41.5 ±4.0	POLVADERA PEAK
86-674	43.1 ±8.5	18.1 ±4.8	156.1 ±6.7	1.7 ±4.6	23.3 ±2.5	74.7 ±5.9	42.2 ±3.9	POLVADERA PEAK
86-675	36.9 ±10.1	10.4 ±6.5	133.9 ±6.7	4.7 ±4.6	22.7 ±2.6	68.3 ±6.0	40.5 ±4.0	POLVADERA PEAK
86-676	56.5 ±10.0	13.5 ±6.7	148.0 ±7.2	1.5 ±4.6	23.1 ±3.1	72.2 ±6.3	44.6 ±4.4	POLVADERA PEAK
86-677	39.7 ±8.7	19.9 ±4.5	151.6 ±6.7	1.6 ±4.6	21.3 ±2.6	70.5 ±5.9	45.0 ±3.9	POLVADERA PEAK
86-678	38.8 ±9.2	18.9 ±4.7	136.6 ±6.7	2.3 ±4.6	24.9 ±2.6	71.8 ±6.0	42.2 ±4.0	POLVADERA PEAK
86-680	41.2 ±8.1	18.2 ±4.7	148.5 ±6.6	3.6 ±4.6	21.6 ±2.5	75.0 ±5.9	44.5 ±3.9	POLVADERA PEAK
86-681	45.3 ±8.0	13.6 ±5.3	138.5 ±6.7	3.9 ±4.6	24.9 ±2.6	68.9 ±6.0	41.7 ±4.0	POLVADERA PEAK
86-682	38.9 ±8.5	21.0 ±4.5	144.3 ±6.6	2.8 ±4.6	25.4 ±2.5	69.5 ±5.9	42.0 ±3.9	POLVADERA PEAK
86-683	48.6 ±7.9	17.9 ±4.8	155.8 ±6.8	0.8 ±4.6	23.1 ±2.6	70.3 ±6.0	43.7 ±4.0	POLVADERA PEAK
86-684	37.3 ±8.7	18.7 ±4.5	136.6 ±6.6	2.9 ±4.6	22.7 ±2.5	68.9 ±5.9	38.3 ±3.9	POLVADERA PEAK

* All trace element values in parts per million (ppm).
± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Abiquiu Dam, New Mexico

Specimen Number	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
	Trace Element Concentrations							
86-686	59.3 ±9.6	18.9 ±5.6	161.4 ±7.3	4.2 ±4.7	23.4 ±3.1	74.4 ±6.3	41.8 ±4.4	POLYADERA PEAK
86-687	49.0 ±9.5	14.0 ±5.9	160.7 ±7.0	3.3 ±4.6	25.0 ±2.8	69.3 ±6.2	51.0 ±4.2	POLYADERA PEAK
86-688	38.5 ±8.8	11.4 ±5.8	141.2 ±6.6	1.4 ±4.6	22.2 ±2.5	67.7 ±6.0	37.8 ±3.9	POLYADERA PEAK
86-690	40.3 ±8.3	13.3 ±5.0	152.1 ±6.7	2.7 ±4.6	26.4 ±2.5	69.8 ±6.0	40.3 ±4.0	POLYADERA PEAK
86-691	46.6 ±8.4	18.3 ±4.8	151.9 ±6.8	3.9 ±4.6	23.3 ±2.6	74.6 ±6.0	42.2 ±4.0	POLYADERA PEAK
86-692	45.7 ±8.1	22.3 ±4.5	148.1 ±6.7	4.6 ±4.6	25.6 ±2.6	70.2 ±6.0	42.2 ±4.0	POLYADERA PEAK
86-694	35.1 ±8.8	17.4 ±4.5	143.9 ±6.6	2.2 ±4.6	23.6 ±2.5	70.2 ±5.9	43.0 ±3.9	POLYADERA PEAK
86-696	71.5 ±11.6	26.4 ±5.8	159.5 ±7.7	2.7 ±4.7	40.5 ±3.3	161.5 ±7.0	46.7 ±4.8	CERRO DEL MEDIO
86-697	50.3 ±7.4	20.0 ±4.5	153.7 ±6.9	0.3 ±4.6	23.8 ±2.5	76.0 ±6.0	39.8 ±4.0	POLYADERA PEAK
86-698	44.5 ±8.4	19.5 ±4.8	159.6 ±6.8	2.4 ±4.6	23.9 ±2.6	77.1 ±6.0	39.9 ±4.0	POLYADERA PEAK
86-699	38.9 ±9.1	15.4 ±5.0	148.9 ±6.7	1.6 ±4.6	23.5 ±2.6	71.1 ±6.0	49.6 ±4.0	POLYADERA PEAK
86-700	42.7 ±9.1	18.3 ±5.0	149.8 ±6.9	0.7 ±4.6	26.0 ±2.7	73.0 ±6.1	37.9 ±4.1	POLYADERA PEAK
86 [illegible]	48.7 ±7.3	18.1 ±4.5	150.5 ±6.6	3.4 ±4.6	24.6 ±2.5	72.8 ±5.9	44.0 ±3.9	POLYADERA PEAK
86-703	39.0 ±8.4	15.0 ±4.8	139.5 ±6.6	3.2 ±4.6	21.4 ±2.5	70.9 ±5.9	43.0 ±3.9	POLYADERA PEAK
86-705	42.6 ±7.8	16.7 ±4.6	151.3 ±6.6	2.1 ±4.6	24.0 ±2.5	74.4 ±5.9	41.5 ±3.9	POLYADERA PEAK
86-707	43.2 ±7.8	13.3 ±5.0	144.1 ±6.7	3.6 ±4.6	24.3 ±2.5	70.7 ±5.9	41.4 ±3.9	POLYADERA PEAK
86-709	43.6 ±7.8	17.1 ±4.6	147.9 ±6.6	3.7 ±4.6	23.3 ±2.5	69.0 ±5.9	44.7 ±3.9	POLYADERA PEAK

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Abiquiu Dam, New Mexico

Specimen Number	Trace Element Concentrations Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-710	42.5 ±8.1	16.1 ±4.7	153.2 ±6.7	1.8 ±4.6	22.4 ±2.6	70.5 ±6.0	42.5 ±4.0	POLVADERA PEAK
86-712	45.8 ±8.8	9.6 ±7.4	137.9 ±6.7	3.4 ±4.6	20.6 ±2.6	66.0 ±6.0	36.2 ±4.0	POLVADERA PEAK
86-713	40.0 ±9.2	22.8 ±4.5	152.2 ±6.7	1.7 ±4.6	21.9 ±2.5	74.9 ±5.9	39.6 ±3.9	POLVADERA PEAK
86-714	39.2 ±8.9	14.9 ±4.9	153.0 ±6.6	4.3 ±4.6	25.8 ±2.5	71.1 ±5.9	42.5 ±3.9	POLVADERA PEAK
86-715	37.2 ±9.3	19.5 ±4.6	145.1 ±6.6	2.5 ±4.6	23.8 ±2.5	69.9 ±5.9	38.5 ±3.9	POLVADERA PEAK
86-717	31.7 ±10.8	17.4 ±4.6	142.6 ±6.6	0.0 ±4.6	24.0 ±2.5	72.5 ±5.9	43.9 ±3.9	POLVADERA PEAK
86-718	84.9 ±10.1	18.4 ±6.5	164.8 ±7.6	3.0 ±4.7	43.7 ±3.2	162.8 ±7.0	50.3 ±4.7	CERRO DEL MEDIO
86-719	40.0 ±9.9	22.4 ±4.7	147.3 ±6.9	2.1 ±4.6	23.9 ±2.8	72.1 ±6.1	40.0 ±4.1	POLVADERA PEAK
86-720	45.8 ±7.9	18.0 ±4.6	145.7 ±6.7	0.4 ±4.6	26.3 ±2.5	71.1 ±6.0	45.5 ±4.0	POLVADERA PEAK
86-721	61.1 ±8.1	20.9 ±4.7	160.8 ±6.8	0.0 ±4.6	40.6 ±2.6	163.7 ±6.2	54.0 ±4.0	CERRO DEL MEDIO
86-722	47.0 ±7.7	19.1 ±4.4	153.1 ±6.6	4.2 ±4.6	23.6 ±2.5	70.3 ±5.9	41.0 ±3.9	POLVADERA PEAK
86-724	36.2 ±9.4	12.6 ±5.1	141.1 ±6.6	2.2 ±4.6	26.0 ±2.5	70.6 ±5.9	38.7 ±3.9	POLVADERA PEAK
86-725	41.8 ±8.0	19.4 ±4.5	148.4 ±6.7	2.0 ±4.6	22.0 ±2.5	70.1 ±6.0	45.4 ±4.0	POLVADERA PEAK
86-726	38.4 ±8.5	12.5 ±5.2	152.3 ±6.7	2.1 ±4.6	22.2 ±2.5	72.7 ±5.9	36.6 ±3.9	POLVADERA PEAK
86-729	45.6 ±7.5	16.1 ±4.7	141.2 ±6.6	2.3 ±4.6	22.5 ±2.5	69.4 ±5.9	41.5 ±3.9	POLVADERA PEAK
86-730	43.3 ±8.7	21.6 ±4.6	153.2 ±6.9	2.0 ±4.6	23.5 ±2.7	71.7 ±6.1	38.5 ±4.2	POLVADERA PEAK
86-731	40.5 ±8.1	15.7 ±4.7	140.6 ±6.7	3.1 ±4.6	24.2 ±2.5	67.1 ±6.0	35.2 ±4.0	POLVADERA PEAK

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Specimen Number	Trace Element Concentrations Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-732	67.4 ±7.6	22.0 ±4.6	160.1 ±6.8	2.9 ±4.6	37.2 ±2.6	165.2 ±6.2	52.8 ±4.1	CERRO DEL MEDIO
86-733	32.3 ±11.6	20.0 ±4.6	153.1 ±6.8	2.6 ±4.6	23.9 ±2.6	70.7 ±6.0	43.3 ±4.1	POLVADERA PEAK
86-734	45.3 ±7.3	16.9 ±4.4	149.0 ±6.7	3.2 ±4.6	25.2 ±2.5	75.3 ±5.9	45.3 ±3.9	POLVADERA PEAK
86-735	35.2 ±9.2	19.4 ±4.5	148.7 ±6.7	4.4 ±4.6	22.3 ±2.5	71.7 ±5.9	43.9 ±3.9	POLVADERA PEAK
86-736	48.3 ±7.4	19.2 ±4.4	140.6 ±6.7	2.8 ±4.6	24.4 ±2.5	66.0 ±6.0	41.1 ±4.0	POLVADERA PEAK
86-737	77.8 ±8.6	20.0 ±5.0	144.0 ±7.0	2.2 ±4.6	34.8 ±2.8	148.2 ±6.4	45.0 ±4.3	CERRO DEL MEDIO
86-738	36.6 ±8.2	15.8 ±4.6	145.9 ±6.6	2.0 ±4.6	22.8 ±2.5	69.1 ±5.9	43.9 ±3.9	POLVADERA PEAK
86-739	44.0 ±8.3	20.9 ±4.6	155.4 ±6.7	2.7 ±4.6	27.4 ±2.5	76.6 ±6.0	45.3 ±4.0	POLVADERA PEAK
86-741	70.6 ±6.7	18.6 ±4.4	149.0 ±6.6	17.5 ±4.7	38.3 ±2.5	153.9 ±6.1	48.7 ±3.9	CERRO DEL MEDIO
86-744	39.1 ±8.2	17.8 ±4.6	147.3 ±6.7	2.5 ±4.6	25.6 ±2.5	68.4 ±6.0	46.0 ±4.0	POLVADERA PEAK
86-745	36.1 ±8.5	17.5 ±4.4	139.1 ±6.6	2.1 ±4.6	22.7 ±2.5	69.3 ±5.9	40.7 ±3.9	POLVADERA PEAK
86-747	42.6 ±8.0	20.2 ±4.4	148.3 ±6.7	0.5 ±4.6	26.0 ±2.5	67.5 ±6.0	47.0 ±4.0	POLVADERA PEAK
86-748	47.8 ±7.0	18.2 ±4.4	148.8 ±6.7	4.1 ±4.6	20.4 ±2.6	70.5 ±5.9	43.0 ±4.0	POLVADERA PEAK
86-749	44.0 ±7.8	18.4 ±4.5	137.0 ±6.6	1.0 ±4.6	19.7 ±2.6	64.8 ±5.9	43.2 ±3.9	POLVADERA PEAK
86-750	74.8 ±7.4	19.6 ±4.8	156.7 ±6.9	0.6 ±4.6	36.6 ±2.7	159.4 ±6.3	50.2 ±4.1	CERRO DEL MEDIO
86-751	42.9 ±8.8	17.3 ±5.0	147.3 ±6.8	3.8 ±4.6	27.3 ±2.6	77.5 ±6.0	46.1 ±4.1	POLVADERA PEAK
86-753	36.9 ±9.2	16.3 ±4.6	126.9 ±6.7	1.1 ±4.6	25.1 ±2.5	69.2 ±6.0	47.6 ±4.0	POLVADERA PEAK

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Abiquiu Dam, New Mexico

Trace Element Concentrations

Specimen Number	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-754	46.3	14.4	141.8	3.1	23.0	67.4	44.4	POLYADERA PEAK
	±7.0	±4.6	±6.6	±4.6	±2.4	±5.9	±3.9	
86-756	41.4	17.6	141.5	1.3	21.9	67.1	42.5	POLYADERA PEAK
	±7.7	±4.5	±6.6	±4.6	±2.5	±5.9	±3.9	
86-757	38.0	14.4	150.1	1.4	23.0	69.7	42.7	POLYADERA PEAK
	±7.7	±4.6	±6.6	±4.6	±2.5	±5.9	±3.9	
86-759	46.2	13.0	152.7	1.7	23.2	77.9	43.3	POLYADERA PEAK
	±8.4	±5.4	±6.8	±4.6	±2.7	±6.0	±4.1	
86-760	42.4	17.7	157.5	2.0	25.0	69.0	40.6	POLYADERA PEAK
	±9.4	±5.1	±7.0	±4.6	±2.8	±6.1	±4.2	
86-761	41.6	20.8	129.5	2.9	21.5	68.4	35.9	POLYADERA PEAK
	±8.4	±4.4	±6.7	±4.6	±2.6	±6.0	±4.0	
86-762	40.7	16.7	136.2	0.0	23.3	77.1	40.0	POLYADERA PEAK
	±8.1	±4.6	±6.6	±4.6	±2.5	±6.0	±4.0	
86-764	46.4	17.2	141.4	4.3	25.2	69.5	43.0	POLYADERA PEAK
	±7.2	±4.4	±6.6	±4.6	±2.5	±5.9	±3.9	
86-765	41.0	15.9	147.6	2.4	24.7	74.8	44.8	POLYADERA PEAK
	±7.7	±4.6	±6.6	±4.6	±2.5	±5.9	±3.9	
86-767	38.3	18.9	144.2	1.0	23.7	68.7	43.0	POLYADERA PEAK
	±8.0	±4.3	±6.7	±4.6	±2.5	±6.0	±4.0	
86-768	36.8	18.0	137.2	3.3	25.8	67.2	42.8	POLYADERA PEAK
	±7.8	±4.3	±6.6	±4.6	±2.4	±5.9	±3.9	
86-770	43.2	17.7	141.8	0.8	23.7	68.6	46.6	POLYADERA PEAK
	±7.3	±4.4	±6.6	±4.6	±2.5	±5.9	±3.9	
86-771	45.0	19.2	148.0	3.3	20.8	68.9	43.9	POLYADERA PEAK
	±7.2	±4.4	±6.6	±4.6	±2.5	±5.9	±3.9	
86-772	40.6	14.6	139.0	2.4	24.8	65.0	41.4	POLYADERA PEAK
	±7.7	±4.7	±6.6	±4.6	±2.5	±5.9	±3.9	
86-773	37.3	14.7	142.1	3.5	22.2	69.3	42.9	POLYADERA PEAK
	±8.0	±4.5	±6.6	±4.6	±2.4	±5.9	±3.9	
86-775	99.5	22.3	208.0	0.1	61.7	175.7	91.2	OBSIDIAN RIDGE
	±6.8	±4.4	±6.9	±4.6	±2.5	±6.2	±4.1	
86-777	48.3	17.1	148.9	4.4	21.1	76.1	47.7	POLYADERA PEAK
	±7.4	±4.6	±6.7	±4.6	±2.6	±6.0	±4.0	

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

Trace Element Concentrations

Specimen Number	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-778	52.1 ±8.1	12.9 ±5.6	157.8 ±6.9	3.9 ±4.6	30.2 ±2.6	79.3 ±6.1	44.4 ±4.1	POLYADERA PEAK
86-779	45.6 ±8.8	16.2 ±5.1	138.1 ±6.9	1.1 ±4.6	23.0 ±2.8	68.9 ±6.1	42.8 ±4.2	POLYADERA PEAK
86-780	55.6 ±7.6	19.1 ±4.5	147.9 ±6.7	1.7 ±4.6	37.7 ±2.5	162.0 ±6.1	49.5 ±4.0	CERRO DEL MEDIO
86-781	52.3 ±7.9	18.9 ±4.8	160.6 ±6.9	3.3 ±4.6	28.3 ±2.7	76.3 ±6.1	49.4 ±4.1	POLYADERA PEAK
86-782	41.7 ±8.4	23.8 ±4.3	148.0 ±6.7	1.9 ±4.6	25.1 ±2.6	70.6 ±6.0	49.1 ±4.0	POLYADERA PEAK
86-783	45.2 ±7.2	13.5 ±4.8	142.4 ±6.7	3.7 ±4.6	22.2 ±2.6	71.9 ±6.0	41.2 ±4.0	POLYADERA PEAK
86-784	38.5 ±9.6	17.5 ±4.9	152.7 ±6.9	1.0 ±4.6	22.5 ±2.7	72.5 ±6.1	42.8 ±4.1	POLYADERA PEAK
86-785	47.9 ±12.6	15.2 ±7.2	120.1 ±7.3	2.4 ±4.7	22.3 ±3.3	58.7 ±6.5	36.1 ±4.6	POLYADERA PEAK
86-786	47.4 ±8.8	15.3 ±5.5	159.7 ±7.0	4.0 ±4.6	24.5 ±2.8	71.6 ±6.1	53.4 ±4.2	POLYADERA PEAK
86-787	45.4 ±10.2	20.6 ±5.4	155.2 ±7.2	2.4 ±4.6	25.5 ±2.9	73.0 ±6.3	43.3 ±4.4	POLYADERA PEAK
86-788	43.4 ±9.1	16.9 ±4.9	146.6 ±6.8	0.9 ±4.6	25.3 ±2.7	71.4 ±6.0	42.4 ±4.1	POLYADERA PEAK
86-789	42.4 ±8.7	17.7 ±4.8	140.3 ±6.8	5.1 ±4.6	27.2 ±2.6	67.7 ±6.1	44.8 ±4.1	POLYADERA PEAK
86-790	38.8 ±18.8	28.0 ±5.8	164.6 ±8.5	4.1 ±4.8	20.1 ±4.3	76.8 ±7.0	45.1 ±5.4	POLYADERA PEAK
86-791	62.7 ±12.3	23.5 ±6.1	153.9 ±7.9	4.7 ±4.7	20.7 ±3.8	76.8 ±6.6	38.5 ±4.9	POLYADERA PEAK
86-792	57.8 ±9.3	16.4 ±5.8	149.3 ±7.3	3.8 ±4.7	18.5 ±3.4	62.6 ±6.4	36.4 ±4.5	POLYADERA PEAK
86-793	37.0 ±14.3	14.8 ±6.4	151.6 ±7.7	3.7 ±4.7	18.6 ±3.7	65.6 ±[illegible].5	46.5 ±4.7	POLYADERA PEAK
86-794	45.9 ±10.8	22.4 ±5.1	163.8 ±7.4	3.1 ±4.7	23.0 ±3.1	70.1 ±6.3	41.4 ±4.5	POLYADERA PEAK

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Abiquiu Dam, New Mexico

Specimen Number	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
	Trace Element Concentrations							
86-795	49.9 ±11.9	17.8 ±6.0	158.8 ±7.7	7.6 ±4.7	29.0 ±3.3	74.6 ±6.5	39.5 ±4.7	POLVADERA PEAK
86-796	50.6 ±8.0	17.5 ±4.9	152.6 ±6.9	0.0 ±4.6	21.0 ±2.8	75.0 ±6.1	42.9 ±4.1	POLVADERA PEAK
86-797	60.2 ±9.0	20.5 ±5.2	159.8 ±7.2	3.6 ±4.6	23.2 ±3.0	69.2 ±6.3	43.5 ±4.4	POLVADERA PEAK
86-798	41.2 ±10.8	14.8 ±6.1	159.8 ±7.2	2.2 ±4.6	23.1 ±3.0	65.2 ±6.3	41.8 ±4.4	POLVADERA PEAK
86-799	50.7 ±9.1	20.5 ±5.0	157.2 ±7.0	3.7 ±4.6	24.1 ±2.8	74.8 ±6.1	45.6 ±4.2	POLVADERA PEAK
86-800	45.7 ±7.8	14.2 ±5.0	137.8 ±6.7	2.3 ±4.6	25.7 ±2.5	67.6 ±6.0	40.8 ±4.0	POLVADERA PEAK
86-801	54.9 ±10.4	18.8 ±6.1	168.3 ±7.8	0.0 ±4.6	26.9 ±3.4	77.4 ±6.5	41.9 ±4.8	POLVADERA PEAK
86-802	45.0 ±7.5	20.5 ±4.4	142.2 ±6.6	0.0 ±4.6	22.1 ±2.5	69.4 ±5.9	39.7 ±3.9	POLVADERA PEAK
86-803	57.6 ±10.4	23.7 ±5.4	151.4 ±7.4	2.0 ±4.6	22.9 ±3.3	67.8 ±6.4	44.6 ±4.5	POLVADERA PEAK
86-804	33.5 ±16.4	15.5 ±6.5	144.9 ±7.5	3.1 ±4.7	26.4 ±3.3	63.5 ±6.5	38.7 ±4.7	POLVADERA PEAK
86-805	49.3 ±13.3	18.1 ±6.9	154.4 ±7.8	0.0 ±4.6	27.3 ±3.4	75.7 ±6.6	36.7 ±4.8	POLVADERA PEAK
86-806	47.9 ±8.5	18.7 ±4.8	154.9 ±6.9	2.3 ±4.6	21.7 ±2.8	70.3 ±6.1	43.5 ±4.2	POLVADERA PEAK
86-807	47.6 ±9.6	18.9 ±5.2	161.5 ±7.1	2.6 ±4.6	23.0 ±3.0	71.0 ±6.2	41.3 ±4.3	POLVADERA PEAK
86-808	42.9 ±9.6	15.9 ±5.5	168.7 ±7.1	4.6 ±4.6	24.1 ±2.9	71.2 ±6.2	43.8 ±4.2	POLVADERA PEAK
86-809	60.8 ±7.5	23.8 ±4.4	145.0 ±6.7	1.6 ±4.6	37.1 ±2.5	151.7 ±6.1	49.1 ±4.0	CERRO DEL MEDIO
86-810	62.8 ±8.7	21.7 ±5.7	144.7 ±7.3	2.1 ±4.6	25.4 ±3.2	61.7 ±6.4	46.1 ±4.5	POLVADERA PEAK
86-811	46.7 ±9.0	18.7 ±5.1	160.9 ±7.0	4.2 ±4.6	23.4 ±2.9	69.0 ±6.1	42.6 ±4.2	POLVADERA PEAK

* All trace element values in parts per million (ppm).
± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Abiquiu Dam, New Mexico

Specimen Number	Trace Element Concentrations							Obsidian Source
	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	
86-812	57.0 ±8.5	17.6 ±5.3	164.6 ±7.2	4.5 ±4.7	25.3 ±3.0	71.1 ±6.2	50.3 ±4.4	POLVADERA PEAK
86-813	46.6 ±7.8	14.6 ±4.9	150.7 ±6.7	3.0 ±4.6	24.4 ±2.5	71.9 ±6.0	40.6 ±4.0	POLVADERA PEAK
86-815	65.2 ±7.5	17.2 ±4.9	138.8 ±6.7	3.4 ±4.6	37.1 ±2.6	150.9 ±6.2	45.8 ±4.0	CERRO DEL MEDIO
86-817	45.8 ±7.4	18.5 ±4.3	133.5 ±6.6	2.1 ±4.6	23.2 ±2.5	66.1 ±5.9	41.9 ±3.9	POLVADERA PEAK
86-819	36.7 ±9.1	14.4 ±4.9	152.6 ±6.7	2.4 ±4.6	25.0 ±2.5	73.1 ±6.0	43.7 ±4.0	POLVADERA PEAK
86-821	42.7 +7.6	12.7 ±4.9	154.0 ±6.6	0.0 ±4.6	26.3 ±2.4	73.4 ±5.9	47.5 ±3.9	POLVADERA PEAK
86-823	43.2 ±7.3	19.4 ±4.3	146.7 ±6.6	0.0 ±4.6	25.9 ±2.4	66.0 ±5.9	43.3 ±3.9	POLVADERA PEAK
86-825	52.0 ±8.2	20.9 ±4.8	156.2 ±7.0	3.1 ±4.6	26.2 ±2.8	70.6 ±6.1	48.6 ±4.2	POLVADERA PEAK
86-826	41.1 ±8.4	13.8 ±5.0	153.4 ±6.8	2.1 ±4.6	23.3 ±2.6	69.9 ±6.0	45.7 ±4.0	POLVADERA PEAK
86-827	42.8 ±9.4	20.1 ±4.9	152.9 7.0	2.7 ±4.6	20.5 ±2.9	73.4 ±6.1	49.1 ±4.2	POLVADERA PEAK
86-828	62.5 ±7.4	21.3 ±4.5	153.2 ±6.8	1.2 ±4.6	37.9 ±2.6	156.2 ±6.2	48.5 ±4.1	CERRO DEL MEDIO
86-829	37.2 ±9.1	18.9 ±4.5	146.1 ±6.7	0.3 ±4.6	24.1 ±2.6	71.2 ±6.0	40.1 ±4.0	POLVADERA PEAK
86-831	40.8 ±7.6	14.3 ±4.7	145.9 ±6.6	2.7 ±4.6	25.2 ±2.5	68.6 ±5.9	45.6 ±3.9	POLVADERA PEAK
86-832	73.6 ±8.8	22.7 ±5.0	166.6 ±7.3	3.9 ±4.7	41.9 ±3.0	162.7 ±6.7	57.3 ±4.4	CERRO DEL MEDIO
86-833	47.9 ±8.3	20.4 ±4.8	148.1 ±7.0	0.7 ±4.6	26.4 ±2.7	71.5 ±6.1	45.2 ±4.2	POLVADERA PEAK
86-834	45.2 ±7.7	16.3 ±4.7	147.1 ±6.7	1.7 ±4.6	23.1 ±2.6	71.0 ±6.0	41.5 ±4.0	POLVADERA PEAK
86-835	53.7 ±7.5	19.0 ±4.5	144.8 ±6.8	1.2 ±4.6	27.9 ±2.6	72.7 ±6.0	44.3 ±4.0	POLVADERA PEAK

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

September 4, 1986

Trace Element Concentrations

Specimen Number	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-836	95.3 ±7.4	21.9 ±4.7	204.6 ±7.0	0.0 ±4.6	56.2 ±2.6	176.8 ±6.3	83.1 ±4.2	OBSIDIAN RIDGE
86-837	43.0 ±7.6	14.9 ±4.7	147.2 ±6.7	1.2 ±4.6	25.8 ±2.5	72.3 ±6.0	40.1 ±4.0	POLVADERA PEAK
86-838	37.3 ±9.0	19.4 ±4.5	145.7 ±6.7	0.7 ±4.6	23.4 ±2.6	69.9 ±6.0	42.3 ±4.0	POLVADERA PEAK
86-840	38.1 ±7.8	17.6 ±4.3	147.4 ±6.6	1.0 ±4.6	22.1 ±2.5	68.7 ±5.9	41.1 ±3.9	POLVADERA PEAK
86-841	42.5 ±9.1	20.6 ±4.8	141.9 ±6.9	2.1 ±4.6	21.4 ±2.8	73.2 ±6.1	37.3 ±4.1	POLVADERA PEAK
86-842	97.2 ±9.3	18.9 ±5.4	180.3 ±7.5	0.0 ±4.6	53.5 ±3.1	161.0 ±6.7	77.5 ±4.7	OBSIDIAN RIDGE
86-843	38.3 ±8.8	23.1 ±4.4	157.2 ±6.8	1.8 ±4.6	25.9 ±2.6	71.6 ±6.0	45.5 ±4.0	POLVADERA PEAK
86-845	42.2 ±8.1	22.9 ±4.3	146.1 ±6.7	2.4 ±4.6	21.6 ±2.6	72.9 ±6.0	39.5 ±4.0	POLVADERA PEAK
86-846	40.4 ±8.9	17.1 ±4.8	152.1 ±6.9	2.5 ±4.6	24.2 ±2.7	71.9 ±6.1	47.8 ±4.1	POLVADERA PEAK
86-847	44.0 ±7.5	18.2 ±4.4	147.3 ±6.6	2.8 ±4.6	22.6 ±2.5	71.4 ±5.9	41.2 ±3.9	POLVADERA PEAK
86-848	30.8 ±10.2	21.0 ±4.2	145.2 ±6.6	2.4 ±4.6	22.4 ±2.5	70.8 ±5.9	35.3 ±3.9	POLVADERA PEAK
86-850	60.6 ±7.6	16.1 ±4.9	158.1 ±6.8	1.7 ±4.6	40.6 ±2.6	151.6 ±6.2	52.1 ±4.1	CERRO DEL MEDIO
86-851	38.1 ±7.9	14.7 ±4.7	145.0 ±6.6	2.6 ±4.6	24.1 ±2.5	67.0 ±5.9	40.0 ±3.9	POLVADERA PEAK
86-853	64.2 ±6.8	16.9 ±4.5	152.5 ±6.7	0.4 ±4.6	39.9 ±2.5	155.5 ±6.1	48.9 ±4.0	CERRO DEL MEDIO
86-854	98.2 ±6.8	23.9 ±4.4	208.1 ±6.9	0.0 ±4.7	58.1 ±2.6	172.5 ±6.2	91.8 ±4.1	OBSIDIAN RIDGE
86-856	41.3 ±7.9	14.6 ±4.7	143.3 ±6.7	0.0 ±4.6	25.2 ±2.5	75.6 ±6.0	40.3 ±4.0	POLVADERA PEAK
86-858	43.5 ±8.7	18.2 ±4.9	147.1 ±6.9	1.6 ±4.6	22.5 ±2.8	65.9 ±6.1	44.4 ±4.2	POLVADERA PEAK

* All trace element values in parts per million (ppm).

± Counting error and fitting error uncertainty at 200 seconds livetime.

Trace Element Concentrations

Specimen Number	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source
86-861	58.9 ±8.1	21.0 ±4.7	155.0 ±6.8	1.4 ±4.6	40.5 ±2.6	161.3 ±6.3	49.9 ±4.1	CERRO DEL MEDIO
86-863	75.5 ±7.4	17.0 ±4.8	156.8 ±6.9	4.1 ±4.6	41.0 ±2.6	166.7 ±6.3	51.7 ±4.1	CERRO DEL MEDIO
86-865	66.9 ±7.1	19.0 ±4.7	140.3 ±6.7	0.0 ±4.6	40.0 ±2.5	148.4 ±6.2	44.8 ±4.0	CERRO DEL MEDIO
86-867	37.7 ±8.5	16.6 ±4.5	144.3 ±6.9	0.9 ±4.6	23.9 ±2.5	70.0 ±6.0	46.8 ±4.0	POLVADERA PEAK
86-868	59.9 ±7.5	17.6 ±4.5	157.2 ±6.7	2.6 ±4.6	38.1 ±2.5	162.0 ±6.2	47.1 ±4.0	CERRO DEL MEDIO
86-869	51.9 ±7.5	19.7 ±4.5	146.8 ±6.7	4.4 ±4.6	23.6 ±2.6	72.8 ±6.0	39.7 ±4.0	POLVADERA PEAK
86-870	49.6 ±6.7	19.6 ±4.2	138.2 ±6.6	1.7 ±4.6	23.9 ±2.4	65.7 ±5.9	40.3 ±3.9	POLVADERA PEAK
86-871	48.3 ±7.2	15.1 ±4.7	146.9 ±6.7	0.8 ±4.6	23.6 ±2.6	68.0 ±6.0	42.0 ±4.0	POLVADERA PEAK
86-873	41.8 ±7.6	18.9 ±4.4	149.2 ±6.6	1.0 ±4.6	22.9 ±2.5	67.0 ±5.9	40.8 ±3.9	POLVADERA PEAK
86-875	43.7 ±7.5	20.0 ±4.3	149.6 ±6.7	3.7 ±4.6	24.4 ±2.5	71.1 ±5.9	41.3 ±3.9	POLVADERA PEAK

* All trace element values in parts per million (ppm).
± Counting error and fitting error uncertainty at 200 seconds livetime.

APPENDIX B

OBSIDIAN HYDRATION REPORT

By

Christopher M. Stevenson

Analytical Results

Two hundred and forty-eight obsidian artifacts from the Abiquiu Dam archaeological project were submitted to the New Mexico State University Obsidian Hydration Dating Laboratory for analysis by Mariah Associates, Albuquerque,NM. The analytical procedures used in compositional analysis, hydration rim measurement, and hydration rate development are discussed below.

Compositional Analysis

In order to determine the geological parent materials of the lithic assemblage each artifact was analyzed for its parts per million concentrations of seven trace elements (Zn, Ga, Rb, Sr, Zr ,Y, Nb) using solid sample XRF analysis (See attachment). Three distinct geological sources of obsidian are represented in the suite of 248 artifacts. Polvadera Peak constitutes the source for the vast majority of lithics (N=220). The Cerro del Medio (N=24) and Obsidian Ridge (N=4) obsidian types are also represented.

Hydration Rim Measurement

A thin section was prepared for each sample under the guidelines presented by Michels and Bebrich (1971). Hydration rim measurements were made at 1000X using a video micromeasurement system with an optical resolution of 0.25 um. Seven independent measurements were made and a mean value and standard deviation were calculated (Table 1). The standard deviations on Table 1 represent precision errors associated with the measurement process. In the calculation of chronometric dates the resolution factor of 0.25 um was substituted for the standard deviation value since it is a realistic estimate of the actual error.

Forty-five artifacts were thin sectioned a second time in order to check for reuse of the specimen. Guidelines for the location of saw cuts were provided by Mariah Associates.

Twelve of the artifacts did not have detectable hydration rims. For the majority of cases the obsidian was either too dark or too crystalline.

Soil Temperature Estimation

Soil temperature data is not availble for the Jemez region. Therefore, in order to estimate the effective hydration temperature (EHT) for the project area, Lee's (1969) temperature integration equation will be used. Using air temperature data from Abiquiu Dam presented in an earlier report compiled by Chambers Consultants and Planners (K. Lord, Chapter 9, Page 7), results in an EHT of:

$$Te = \frac{(Ta + 1.2316) + (0.1607 * Rt)}{1.0645}$$

$$= \frac{(9.80 + 1.2316) + (0.1607 * 25.28)}{1.0645}$$

$$= 14.18\ ^{o}C$$

where: Ta = mean annual air temperature (^{o}C)

Rt = the range in mean annual air temperature (^{o}C)

<u>Hydration Rate Development</u>

The NMSU induced hydration rate experiment for the Polvadera Peak obsidian source is still in progress. However, a preliminary hydration rate may be derived using the "Chemical Index" of Friedman and Long (1976). Input values for the equation were developed at NMSU thro.gh the compositional analysis of Polvadera Peak obsidian by inductively coupled plasma atomic emission spectroscopy. Intrinsic water content values were obtained by the use of the Penfield technique.

$$CI = SiO_2 - 45(CaO + MgO) - 20(H_2O+)$$

$$= 75.67 - 45(0.45 + 0.05) - 20(0.24)$$

$$= 48.37$$

Using the conversion graphs of Friedman and Long (1976) the obsidian hydration rate for Polvadera Peak at 14.18oC is 10.40 um2/1000 years. This hydration rate has been used to calculate the chronometric dates on Table 2. A similar calculation for the Obsidian Ridge glass (SiO2=76.38, CaO=0.35, MgO=0.03, H2O+=0.44) results in a CI of 50.5 and a hydration rate of 11.5um2/1000 years. The necessary input parameters for Cerro del Medio are not available at this time.

Table B.1 Stevenson's Obsidian Hydration Rim Measurements and Provenience Data for Abiquiu Obsidian Artifacts.[1]

Lab No.	(Site-Lot-Unit-NGrid-EGrid-[Artifact] No.)	Width	S.D.	*Group
Debitage				
86-288	27042-173-2-240-271	3.52	0.05	POL
86-289	27042-173-2-240-271	2.43	0.04	POL
86-290	27042-172-2-240-271	3.08	0.04	POL
86-291	27042-172-2-240-271	3.24	0.04	POL
86-292	27042-172-2-240-271	3.60	0.03	POL
86-293	27042-172-2-240-271	3.63	0.03	POL
86-294	27042-172-2-240-271	3.55	0.05	POL
86-295	27042-132-2-240-271	3.56	0.05	POL
86-296	27042-125-2-242-273	4.25	0.03	POL
86-297	27042-122-2-243-272	3.54	0.04	POL
86-298	27042-124-2-243-273	2.45	0.03	POL
86-299	27042-154-2-244-273	8.27 4.68	0.03 0.03	POL
86-300	27042-72-3-270-301	3.61	0.03	POL
86-301	27042-68-3-272-300	3.62	0.03	POL
86-302	27042-68-3-272-300	3.56	0.03	POL
86-303	27042-96-4-309-286	4.26	0.06	POL
86-304	27042-97-4-309-286	4.76	0.03	POL
86-305	27042-88-4-309-293	4.05	0.03	POL
86-306	27042-99-4-310-287	4.44	0.09	POL
86-307	25480-641-1-394-333	4.17 1.78	0.03 0.05	POL
86-308	25480-690-1-335	3.35	0.05	POL
86-309	25480-650-1-408-333	3.11	0.03	POL
86-310	25480-701-1-409-335	2.26	0.01	POL

86-311	25480-703-1-411-335	3.22	0.04	POL
86-312	25480-570-1-414-330	4.61	0.03	POL
86-313	25480-604-1-415-331	5.13	0.04	POL
86-314	25480-606-1-416-331	4.74	0.06	POL
86-315	25480-578-1-419-330	3.48	0.03	POL
86-316	25480-796-1-419-330	16.14 3.77	0.06 0.03	POL
86-317	25480-799-1-419-330	3.10	0.03	POL
86-318	25480-800-1-419-330	2.92	0.02	POL
86-319	25480-90-2-394-300	4.68	0.06	MED
86-320	25480-801-2-394-300	4.08	0.04	MED
86-321	25480-91-2-394-301	3.18	0.03	MED
86-322	25480-93-2-394-303	4.79 3.26	0.03 0.03	MED
86-323	25480-43-2-396-300	3.67	0.03	POL
86-324	25480-272-3-382-300	4.70	0.02	MED
86-325	25480-687-1-391-335	4.17	0.04	POL
86-326	27018-372-1-101-100	3.43	0.03	POL
86-327	27018-374-1-101-104	3.61	0.04	POL
86-328	27018-271-1-106-105	----	----	POL
86-329	25532-2-114-125-1	3.50	0.03	POL
86-330	25532-208-2-117-132	3.57	0.04	POL
86-331	25532-207-2-118-130	2.80	0.03	POL
86-332	25532-286-2-114-125	3.02	0.04	POL
86-333	25532-83-1-128-107	2.31	0.02	POL
86-334	25532-85-1-128-108	1.77	0.03	POL
86-335	27020-5-1-108-118	4.07	0.04	POL
86-336	25330-425-1-122-128	4.63	0.05	POL
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86-337	25330-389-1-120-128	4.33	0.03	POL
86-338	25330-405-1-121-127	4.89	0.03	POL
86-339	25330-172-1-108-125	4.86	0.05	POL
86-340	25330-325-1-117-129	4.04	0.07	POL
86-341	51698-71-3-104-90	3.11	0.02	POL
86-342	51698-33-3-102-91	3.69	0.03	MED

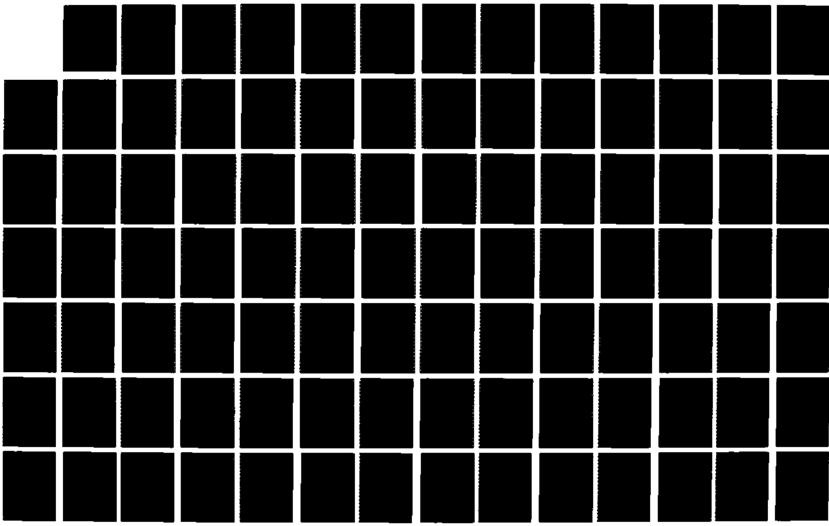
86-343	51698-41-3-91-93	3.56	0.05	PCL
86-344	51700-224-1-316-293	3.57	0.04	POL
86-345	51700-66-2-344-309	2.97	0.04	POL
86-346	51700-16-2-345-302	3.36	0.02	POL
86-347	51700-73-2-348-309	3.37	0.02	POL
86-348	27041-45-1-129-109	3.03	0.03	POL
86-349	27041-129-1-126-107	3.29	0.03	POL
86-350	27041-104-1-125-108	3.31	0.02	POL
86-351	27041-91-1-125-114	4.11	0.03	POL
86-352	27041- 86-1-124-114-2	4.63	0.04	POL
86-353	27041-185-1-124-114-1	2.36	0.03	POL
86-354	27041-186-1-124-114-2	2.72	0.05	POL
86-355	27041-186-1-124-114-1	2.32	0.04	POL
86-356	27041-185-1-124-114	3.54	0.02	POL
86-357	25328-587-5-87-109	3.82	0.04	POL
86-358	25328-581-5-87-103	3.99	0.07	POL
86-359	25328-91-2-105-125	4.06	0.05	POL
86-360	25328-170-4-46-84	3.10	0.04	POL
86-361	25328-179-4-45-84	4.13 3.19	0.02 0.04	POL
86-362	25328-206-44-83	4.14	0.02	POL
86-363	25328-393-3-56-150	4.86	0.04	POL
86-364	25328-442-3-55-152	2.39	0.06	POL
86-365	25328-443-3-53-152	4.52 5.31	0.04 0.04	POL
86-366	25328-425-3-52-153	2.87	0.03	POL
86-367	25228-84-1-153-55	6.08 4.06	0.06 0.03	POL
86-368	25328-65-1-151-58	3.75	0.04	POL
86-369	25328-729-5-95-111	3.55	0.04	POL
86-370	25328-730-5-95-112	2.63	0.03	POL
86-371	25328-825-6-54-129-1	4.08	0.03	POL
86-372	25328-691-5-93-104	4.20	0.04	POL
86-373	25328-688-5-93-101	3.54	0.06	POL
86-374	25328-695-5-92-104	3.94	0.04	POL

86-375	25328-655-5-90-109	3.35	0.03	POL
86-376	25328-632-5-89-111	3.93	0.06	POL
86-377	25328-629-5-88-110	3.50	0.02	POL
86-378	25328-627-5-88-108	3.33	0.06	POL

Tools

86-673	27002-6	3.56	0.03	POL
86-674	51700-13	3.62	0.02	POL
86-675	51702-4 (C1)	3.00	0.05	POL
86-675A	51702-4 (C2)	----	----	POL
86-676	51700-5	4.42	0.05	POL
86-677	25330-31	4.91	0.04	POL
86-678	25480-40 (C1)	3.11	0.03	POL
86-679	25480-40 (C2)	3.06	0.05	POL
86-680	51700-4	4.01 3.47	0.02 0.03	POL
86-681	25480-5	4.62	0.03	POL
86-682	27042-8	3.96	0.05	POL
86-683	27041-12	4.51	0.04	POL
86-684	27018-31 (C1)	5.49	0.04	POL
86-685	27018-31 (C2)	4.88	0.03	POL
86-686	25330-4	5.48	0.06	POL
86-687	25328-3	3.73	0.03	POL
86-688	25532-13 (C1)	4.81	0.04	POL
86-689	25532-13 (C2)	2.99	0.07	POL
86-690	27030-9	4.03	0.03	POL
86-691	27002-4	3.64	0.03	POL
86-692	27042-4 (C1)	4.50	0.05	POL
86-693	27042-4 (C2)	4.51	0.05	POL
86-694	25330-10 (C1)	2.68	0.03	POL
86-695	25330-10 (C2)	2.70	0.04	POL
86-696	25532-16	3.22	0.04	MED
86-697	51703-14	2.87	0.03	POL
86-698	25480-32	2.86	0.03	POL
86-699	27042-13	4.06	0.04	POL

AD-A227 200 REPORT OF SURFACE COLLECTION AND TESTING AT 18 SITES 6/7
NEAR ABIQUIU RESERVO (U) MARIAH ASSOCIATES INC
ALBUQUERQUE NM J B BERTRAM ET AL OCT 89 XA-COE/NM
UNCLASSIFIED DACW47-86-D-0002 F/G 5/6 NL



86-731	25480-10	3.92	0.05	POL
86-732	51700-7	4.07	0.03	MED
86-733	25532-15	2.24	0.03	POL
86-734	25328-24	3.26	0.04	POL
		2.54	0.03	
86-735	27018-33	----	----	POL
86-736	27018-10	3.76	0.04	POL
86-737	25333-6	5.17	0.02	MED
86-738	27002-7	3.50	0.04	POL
86-739	27041-13 (C1)	3.95	0.02	POL
86-740	27041-13 (C2)	3.60	0.03	POL
86-741	25328-28 (C1)	4.03	0.03	MED
		3.63	0.06	
86-742	25328-28 (C2)	3.25	0.04	MED
		4.48	0.03	
86-743	25328-28 (C3)	3.49	0.03	MED
86-744	27002-9	3.45	0.02	POL
86-745	27018-20 (C1)	4.55	0.06	POL
86-746	27018-20 (C2)	3.79	0.03	POL
		4.39	0.04	
86-747	25328-1	3.79	0.05	POL
86-748	27042-12	4.33	0.03	POL
86-749	25480-17	3.64	0.04	POL
86-750	25480-33	4.48	0.07	MED
86-751	27018-47 (C1)	3.20	0.05	POL
86-752	27018-47 (C2)	3.11	0.02	POL
86-753	27041-19	3.38	0.04	POL
86-754	25330-14 (C1)	2.53	0.03	POL
86-755	25330-14 (C2)	2.76	0.02	POL
86-756	27041-7	3.89	0.03	POL
ááááááááá				
86-757	27002-1 (C1)	4.13	0.02	POL
86-758	27002-1 (C2)	3.79	0.04	POL
ááááááááá				
86-759	25480-38	3.35	0.03	POL
86-760	27018-48	2.91	0.02	POL
86-761	27018-49	3.25	0.04	POL

86-762	25330-28 (C1)	3.41	0.04	POL
86-763	25330-28 (C2)	3.97 3.42	0.03 0.04	POL
86-764	25328-8	2.59	0.03	POL
86-765	25328-45 (C1)	3.04 4.72 3.77	0.04 0.05 0.02	POL
86-766	25328-45 (C2)	3.73	0.04	POL
86-767	25480-22	2.83	0.03	POL
86-768	25532-5 (C1)	3.00	0.03	POL
86-769	25532-5 (C2)	2.77	0.03	POL
86-770	27042-7	4.44	0.04	POL
86-771	25532-8	2.51	0.02	POL
86-772	51698-3	2.46	0.02	POL
86-773	25480-1 (C1)	3.00	0.03	POL
86-774	25480-1 (C2)	3.41 2.73	0.03 0.02	POL
86-775	51703-4 (C1)	----	----	OR
86-776	51703-4 (C2)	----	----	OR

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86-777	27018-579	6.65 4.60	0.06 0.03	POL
86-778	27018-580	3.35	0.02	POL
86-779	27018-175	3.66	0.02	POL
86-780	51698-71	4.52	0.03	MED
86-781	27018-587	3.51	0.03	POL
86-782	27018-588	----	----	POL
86-783	51700-226	3.29	0.04	POL
86-784	25480-110	3.84	0.04	POL
86-785	27042-152	4.41	0.03	POL
86-786	51700-39	3.60	0.03	POL
86-787	51700-30	3.22	0.03	POL
86-788	27002-48	3.62	0.04	POL
86-789	25328-681	4.79	0.04	POL
86-790	27018-282	3.59	0.05	POL
86-791	27018-251	3.37	0.04	POL

86-792	27018-329	3.78	0.03	POL
86-793	27018-285	3.23	0.04	POL
86-794	27018-324	4.76	0.05	POL
86-795	27041-106	2.62	0.09	POL
86-796	25328-234	4.30	0.04	POL
86-797	27041-118	3.09	0.04	POL
86-798	27041-114	3.72	0.02	POL
86-799	25532-201	3.33	0.04	POL
86-800	27041-57	4.43	0.03	POL
86-801	25328-628	4.13	0.03	POL
86-802	25532-219	3.66	0.03	POL
86-803	27041-67	5.13	0.03	POL
86-804	25328-625	3.23	0.04	POL
86-805	25328-74	3.40	0.05	POL
86-806	25328-59	3.21	0.06	POL
86-807	25328-68	3.75	0.03	POL
86-808	25328-42	3.35	0.02	POL
86-809	25328-1	----	----	MED
86-810	25328-653	3.24	0.03	POL
86-811	25328-470	3.27	0.03	POL
86-812	25328-656	3.48	0.06	POL

Tools

86-813	27018-3 (C1)	3.26	0.03	POL
86-814	27018-3 (C2)	3.26	0.02	POL
86-815	27018-12 (C1)	3.85	0.05	MED
86-816	27018-12 (C2)	4.28	0.04	MED
86-817	27018-28 (C1)	3.65	0.04	POL
86-818	27018-28 (C2)	3.44	0.02	POL
86-819	27018-26 (C1)	5.56	0.05	POL
86-820	27018-26 (C2)	----	----	POL
86-821	27018-6 (C1)	3.09	0.03	POL
86-822	27018-6 (C2)	2.68	0.04	POL
86-823	27018-2 (C1)	3.36	0.04	POL
86-824	27018-2 (C2)	4.62	0.03	POL

86-825	25532-2	4.15	0.04	POL
86-826	25532-10	3.26	0.03	POL
86-827	27002-2	4.43	0.02	POL
86-828	27002-5	4.38	0.02	MED
86-829	27041-2 (C1)	3.35	0.02	POL
86-830	27041-2 (C2)	3.29	0.03	POL
86-831	51703-12	12.87	0.07	POL
86-832	25480-25	----	----	MED
86-833	25480-4	3.74	0.03	POL
86-834	25480-3	4.30	0.02	POL
86-835	25480-23	2.81	0.04	POL
86-836	25480-9	5.39	0.05	OR
86-837	25480-6	3.96	0.04	POL
86-838	25480-13 (C1)	3.34	0.04	POL
86-839	25480-13 (C2)	3.35	0.03	POL
86-840	25480-21	3.35	0.04	POL
86-841	25333-8	4.07	0.03	POL
86-842	25330-12	----	----	OR
86-843	27020-11 (C1)	3.38	0.03	POL
86-844	27020-11 (C2)	3.12	0.03	POL
86-845	27041-1	3.84	0.03	POL
86-846	27020-11	2.71	0.04	POL
86-847	27020-14	3.46	0.07	POL
86-848	27020-12 (C1)	5.07	0.05	POL
86-849	27020-12 (C2)	----	----	POL
86-850	51698-1	7.21 4.29	0.05 0.02	MED
86-851	51698-7 (C1)	2.15	0.04	POL
86-852	51698-7 (C2)	2.48	0.04	POL
86-853	51698-5	2.31	0.04	MED
86-854	51700-10 (C1)	3.43	0.03	OR
86-855	51700-10 (C2)	3.13	0.06	OR
86-856	51700-9 (C1)	4.47	0.03	POL
86-857	51700-9 (C2)	4.61	0.04	POL

86-858	51700-6	4.40	0.03	POL
86-859	51700-2 (C1)	3.80	0.04	---
86-860	51700-2 (C2)	3.80	0.03	---
86-861	25328-42 (C1)	6.69	0.05	MED
aaaaaaaaa		3.77	0.03	
86-862	25328-42 (C2)	4.12	0.03	MED
aaaaaaaaa		3.76	0.03	
86-863	25328-43 (C1)	3.17	0.05	MED
86-864	25328-43 (C2)	3.10	0.04	MED
86-865	25328-23 (C1)	3.97	0.03	MED
86-866	25328-23 (C2)	4.07	0.04	MED
86-867	25328-7	3.15	0.04	POL
86-868	25328-21	4.22	0.03	MED
86-869	25328-6	5.07	0.04	POL
86-870	25328-19	4.48	0.05	POL
86-871	27042-6 (C1)	4.39	0.03	POL
86-872	27042-6 (C2)	4.42	0.03	POL
86-873	27042-2 (C1)	4.25	0.03	POL
86-874	27042-2 (C2)	----	----	POL
86-875	27042-10 (C1)	6.16	0.05	POL
86-876	27042-10 (C2)	3.30	0.04	POL

1 POL = Polvadera Peak
MED = Cerro del Medio
OR = Obsidian Ridge
(C1) = Cut 1
(C2) = Cut 2aaaaaaaa
aaaaaaaa = Second cut or second reading on item

Table B.2A Stevenson's Obsidian Hydration Dates for Polvadera Peak Samples Using 10.40 um^2/1,000 Years.

Sample	Rim	S.D.	Date	S.D.
86-288	3.52 u	+/- .25	795 AD	+/-175 yrs
86-289	2.43 u	+/- .25	1419 AD	+/-123 yrs
86-290	3.08 u	+/- 25	1074 AD	+/-154 yrs
86-291	3.24 u	+/- .25	977 AD	+/-162 yrs
86-292	3.6 u	+/- .25	740 AD	+/-179 yrs
86-293	3.63 u	+/- .25	719 AD	+/-180 yrs
86-294	3.55 u	+/- .25	775 AD	+/-177 yrs
86-295	3.56 u	+/- .25	768 AD	+/-177 yrs
86-296	4.25 u	+/- .25	250 AD	+/-211 yrs
86-297	3.54 u	+/- .25	782 AD	+/-177 yrs
86-298	2.45 u	+/- .25	1409 AD	+/-123 yrs
86-299	8.27 u	+/- .25	4590 BC	+/-403 yrs
86-299	4.68 u	+/- .25	120 BC	+/-231 yrs
86-300	3.61 u	+/- .25	733 AD	+/-179 yrs
86-301	3.62 u	+/- .25	726 AD	+/-180 yrs
86-302	3.56 u	+/- .25	768 AD	+/-177 yrs
86-303	4.26 u	+/- .25	242 AD	+/-211 yrs
86-304	4.76 u	+/- .25	192 BC	+/-235 yrs
86-305	4.05 u	+/- .25	409 AD	+/-200 yrs
86-306	4.44 u	+/- .25	91 AD	+/-220 yrs
86-307	4.17 u	+/- .25	314 AD	+/-206 yrs
86-307	1.78 u	+/- .25	1682 AD	+/- 92 yrs
86-308	3.35 u	+/- .25	907 AD	+/-167 yrs
86-309	3.11 u	+/- .25	1056 AD	+/-155 yrs
86-310	2.26 u	+/- .25	1495 AD	+/-114 yrs
86-311	3.22 u	+/- .25	990 AD	+/-161 yrs
86-312	4.61 u	+/- .25	57 BC	+/-228 yrs
86-313	5.13 u	+/- .25	544 BC	+/-253 yrs
86-314	4.74 u	+/- .25	174 BC	+/-234 yrs
86-315	3.48 u	+/- .25	822 AD	+/-173 yrs
86-316	16.14 u	+/- .25	%23062 BC	+/-782 yrs
86-316	3.77 u	+/- .25	620 AD	+/-193 yrs
86-317	3.1 u	+/- .25	1062 AD	+/-155 yrs
86-318	2.92 u	+/- .25	1167 AD	+/-147 yrs
86-323	3.67 u	+/- .25	691 AD	+/-182 yrs
86-325	4.17 u	+/- .25	314 AD	+/-206 yrs
86-326	3.43 u	+/- .25	855 AD	+/-171 yrs
86-327	3.61 u	+/- .25	733 AD	+/-179 yrs
86-329	3.5 u	+/- .25	809 AD	+/-175 yrs
86-330	3.57 u	+/- .25	761 AD	+/-175 yrs
86-331	2.8 u	+/- .25	1233 AD	+/-141 yrs
86-332	3.02 u	+/- .25	1110 AD	+/-152 yrs
86-333	2.31 u	+/- .25	1473 AD	+/-117 yrs
86-334	1.77 u	+/- .25	1685 AD	+/- 91 yrs
86-335	4.07 u	+/- .25	394 AD	+/-202 yrs
86-336	4.63 u	+/- .25	75 BC	+/-228 yrs
86-337	4.33 u	+/- .25	184 AD	+/-214 yrs
86-338	4.89 u	+/- .25	313 BC	+/-241 yrs
86-339	4.86 u	+/- .25	285 BC	+/-239 yrs
86-340	4.04 u	+/- .25	417 AD	+/-200 yrs
86-341	3.11 u	+/- .25	1056 AD	+/-155 yrs
86-343	3.56 u	+/- .25	768 AD	+/-177 yrs
86-344	3.57 u	+/- .25	761 AD	+/-178 yrs
86-345	2.97 u	+/- .25	1138 AD	+/-148 yrs
86-346	3.36 u	+/- .25	901 AD	+/-169 yrs
86-347	3.37 u	+/- .25	894 AD	+/-168 yrs

86-348	3.03u	+/-.25	1104 AD	+/-152 yrs
86-349	3.29 u	+/- .25	946 AD	+/-164 yrs
86-350	3.31 u	+/- .25	933 AD	+/-165 yrs
86-351	4.11 u	+/- .25	362 AD	+/-203 yrs
86-352	4.63 u	+/- .25	75 BC	+/-228 yrs
86-353	2.36 u	+/- .25	1451 AD	+/-120 yrs
86-354	2.72 u	+/- .25	1275 AD	+/-137 yrs
86-355	2.32 u	+/- .25	1469 AD	+/-118 yrs
86-356	3.54 u	+/- .25	782 AD	+/-177 yrs
86-357	3.82 u	+/- .25	583 AD	+/-189 yrs
86-358	3.99 u	+/- .25	456 AD	+/-198 yrs
86-359	4.06 u	+/- .25	402 AD	+/-202 yrs
86-360	3.1 u	+/- .25	1062 AD	+/-155 yrs
86-361	4.13 u	+/- .25	346 AD	+/-204 yrs
86-361	3.19 u	+/- .25	1008 AD	+/-159 yrs
86-362	4.14 u	+/- .25	338 AD	+/-205 yrs
86-363	4.86 u	+/- .25	285 BC	+/-239 yrs
86-364	3.39 u	+/- .25	881 AD	+/-169 yrs
86-365	4.52 u	+/- .25	22 AD	+/-223 yrs
86-365	5.31 u	+/- .25	725 BC	+/-261 yrs
86-366	2.87 u	+/- .25	1194 AD	+/-144 yrs
86-367	6.08 u	+/- .25	1568 BC	+/-298 yrs
86-367	4.06 u	+/- .25	402 AD	+/-202 yrs
86-368	3.75 u	+/- .25	634 AD	+/-186 yrs
86-369	3.55 u	+/- .25	775 AD	+/-177 yrs
86-370	2.63 u	+/- .25	1321 AD	+/-132 yrs
86-371	4.08 u	+/- .25	386 AD	+/-202 yrs
86-372	4.2 u	+/- .25	290 AD	+/-208 yrs
86-373	3.54 u	+/- .25	782 AD	+/-177 yrs
86-374	3.94 u	+/- .25	494 AD	+/-196 yrs

Table B.2B Stevenson's Obsidian Hydration Dates for Polvadera Peak Samples Using 10.40 um^2/1,000 Years.

Sample	Rim	S.D.	Date	S.D.
86-673	3.56 u	+/- .25	768 AD	+/-177 yrs
86-674	3.62 u	+/- .25	726 AD	+/-180 yrs
86-675	3 u	+/- .25	1121 AD	+/-150 yrs
86-676	4.42 u	+/- .25	108 AD	+/-219 yrs
86-677	4.91 u	+/- .25	332 BC	+/-242 yrs
86-678	3.11 u	+/- .25	1056 AD	+/-155 yrs
86-679	3.06 u	+/- .25	1086 AD	+/-153 yrs
86-680	4.01 u	+/- .25	440 AD	+/-198 yrs
86-680	3.47 u	+/- .25	829 AD	+/-173 yrs
86-681	4.62 u	+/- .25	66 BC	+/-228 yrs
86-682	3.96 u	+/- .25	479 AD	+/-197 yrs
86-683	4.51 u	+/- .25	31 AD	+/-223 yrs
86-684	5.49 u	+/- .25	912 BC	+/-270 yrs
86-685	4.88 u	+/- .25	303 BC	+/-241 yrs
86-686	5.48 u	+/- .25	901 BC	+/-270 yrs
86-687	3.73 u	+/- .25	649 AD	+/-186 yrs
86-688	4.81 u	+/- .25	238 BC	+/-237 yrs
86-689	2.99 u	+/- .25	1127 AD	+/-150 yrs
86-690	4.03 u	+/- .25	425 AD	+/-200 yrs
86-691	3.64 u	+/- .25	712 AD	+/-181 yrs
86-692	4.5 u	+/- .25	39 AD	+/-222 yrs
86-693	4.51 u	+/- .25	31 AD	+/-223 yrs
86-694	2.68 u	+/- .25	1296 AD	+/-135 yrs
86-695	2.7 u	+/- .25	1286 AD	+/-136 yrs
86-697	2.87 u	+/- .25	1194 AD	+/-144 yrs
86-698	2.86 u	+/- .25	1200 AD	+/-144 yrs
86-699	4.06 u	+/- .25	402 AD	+/-202 yrs
86-700	3.22 u	+/- .25	990 AD	+/-161 yrs
86-701	2.75 u	+/- .25	1259 AD	+/-138 yrs
86-702	3.54 u	+/- .25	782 AD	+/-177 yrs
86-702	2.87 u	+/- .25	1194 AD	+/-144 yrs
86-703	4.25 u	+/- .25	250 AD	+/-211 yrs
86-704	3.7 u	+/- .25	670 AD	+/-184 yrs
86-704	3.03 u	+/- .25	1104 AD	+/-152 yrs
86-705	3.7 u	+/- .25	670 AD	+/-184 yrs
86-706	3.8 u	+/- .25	598 AD	+/-189 yrs
86-707	2.63 u	+/- .25	1321 AD	+/-132 yrs
86-708	3.16 u	+/- .25	1026 AD	+/-158 yrs
86-709	3.46 u	+/- .25	835 AD	+/-172 yrs
86-710	4.05 u	+/- .25	409 AD	+/-200 yrs
86-711	4.29 u	+/- .25	217 AD	+/-212 yrs
86-712	3.54 u	+/- .25	782 AD	+/-177 yrs
86-713	2.13 u	+/- .25	1550 AD	+/-108 yrs
86-713	3.56 u	+/- .25	768 AD	+/-177 yrs
86-714	3.67 u	+/- .25	691 AD	+/-182 yrs
86-715	.94 u	+/- .25	1902 AD	+/- 52 yrs
86-715	3.12 u	+/- .25	1050 AD	+/-156 yrs
86-716	1.87 u	+/- .25	1650 AD	+/- 96 yrs
86-716	2.72 u	+/- .25	1275 AD	+/-137 yrs
86-717	3.06 u	+/- .25	1086 AD	+/-153 yrs
86-719	5.27 u	+/- .25	684 BC	+/-259 yrs
86-719	3.88 u	+/- .25	539 AD	+/-193 yrs
86-720	4.42 u	+/- .25	108 AD	+/-219 yrs
86-722	3.32 u	+/- .25	927 AD	+/-166 yrs
86-723	3.04 u	+/- .25	1099 AD	+/-152 yrs
86-724	3.81 u	+/- .25	591 AD	+/-189 yrs
86-725	4.21 u	+/- .25	282 AD	+/-202 yrs

86-726	3.69 u	+/- .25	677 AD	+/-183 yrs
86-727	4.87 u	+/- .25	294 BC	+/-240 yrs
86-728	4.46 u	+/- .25	74 AD	+/-221 yrs
86-729	3.69 u	+/- .25	677 AD	+/-183 yrs
86-730	3.4 u	+/- .25	875 AD	+/-170 yrs
86-731	3.92 u	+/- .25	509 AD	+/-195 yrs
86-733	2.24 u	+/- .25	1504 AD	+/-114 yrs
86-734	3.26 u	+/- .25	965 AD	+/-163 yrs
86-734	2.54 u	+/- .25	1366 AD	+/-128 yrs
86-736	3.76 u	+/- .25	627 AD	+/-187 yrs
86-738	3.5 u	+/- .25	809 AD	+/-175 yrs
86-739	3.95 u	+/- .25	486 AD	+/-196 yrs
86-740	3.6 u	+/- .25	740 AD	+/-179 yrs
86-744	3.45 u	+/- .25	842 AD	+/-172 yrs
86-745	4.55 u	+/- .25	4 BC	+/-225 yrs
86-746	3.79 u	+/- .25	605 AD	+/-188 yrs
86-746	4.39 u	+/- .25	133 AD	+/-217 yrs
86-747	3.79 u	+/- .25	605 AD	+/-188 yrs
86-748	4.33 u	+/- .25	184 AD	+/-214 yrs
86-749	3.64 u	+/- .25	712 AD	+/-181 yrs
86-751	3.2 u	+/- .25	1002 AD	+/-160 yrs
86-752	3.11 u	+/- .25	1056 AD	+/-155 yrs
86-753	3.38 u	+/- .25	888 AD	+/-169 yrs
86-754	2.53 u	+/- .25	1371 AD	+/-128 yrs
86-755	2.76 u	+/- .25	1254 AD	+/-139 yrs
86-756	3.89 u	+/- .25	531 AD	+/-193 yrs
86-757	4.13 u	+/- .25	346 AD	+/-204 yrs
86-758	3.79 u	+/- .25	605 AD	+/-188 yrs
86-759	3.35 u	+/- .25	907 AD	+/-167 yrs
86-760	2.91 u	+/- .25	1172 AD	+/-146 yrs
86-761	3.25 u	+/- .25	971 AD	+/-162 yrs
86-762	3.41 u	+/- .25	868 AD	+/-170 yrs
86-763	3.97 u	+/- .25	471 AD	+/-197 yrs
86-763	3.42 u	+/- .25	862 AD	+/-171 yrs
86-764	2.59 u	+/- .25	1341 AD	+/-130 yrs
86-765	3.04 u	+/- .25	1098 AD	+/-152 yrs
86-765	4.72 u	+/- .25	156 BC	+/-233 yrs
86-765	3.77 u	+/- .25	620 AD	+/-187 yrs
86-766	3.73 u	+/- .25	649 AD	+/-186 yrs
86-767	2.83 u	+/- .25	1216 AD	+/-142 yrs
86-768	3 u	+/- .25	1121 AD	+/-150 yrs
86-769	2.77 u	+/- .25	1249 AD	+/-139 yrs
86-770	4.44 u	+/- .25	91 AD	+/-220 yrs
86-771	2.51 u	+/- .25	1381 AD	+/-127 yrs
86-772	2.46 u	+/- .25	1405 AD	+/-125 yrs
86-773	3 u	+/- .25	1121 AD	+/-150 yrs
86-774	3.41 u	+/- .25	868 AD	+/-170 yrs
86-774	2.73 u	+/- .25	1270 AD	+/-137 yrs
86-777	6.65 u	+/- .25	2266 BC	+/-325 yrs
86-777	4.6 u	+/- .25	48 BC	+/-227 yrs
86-778	3.35 u	+/- .25	907 AD	+/-167 yrs
86-779	3.66 u	+/- .25	698 AD	+/-182 yrs
86-781	3.51 u	+/- .25	802 AD	+/-175 yrs
86-783	3.29 u	+/- .25	946 AD	+/-164 yrs
86-784	3.84 u	+/- .25	569 AD	+/-191 yrs
86-785	4.41 u	+/- .25	116 AD	+/-218 yrs
86-786	3.6 u	+/- .25	740 AD	+/-179 yrs
86-787	3.22 u	+/- .25	990 AD	+/-161 yrs
86-788	3.62 u	+/- .25	726 AD	+/-180 yrs
86-789	4.79 u	+/- .25	220 BC	+/-236 yrs
86-790	3.59 u	+/- .25	747 AD	+/-178 yrs
86-791	3.37 u	+/- .25	894 AD	+/-168 yrs
86-792	3.78 u	+/- .25	613 AD	+/-188 yrs
86-793	3.23 u	+/- .25	983 AD	+/-161 yrs
86-794	4.76 u	+/- .25	192 BC	+/-235 yrs

86-795	2.62 u	+/-.25	1326 AD	+/-126 yrs
86-796	4.3 u	+/- .25	209 AD	+/-213 yrs
86-797	3.09 u	+/- .25	1068 AD	+/-154 yrs
86-798	3.72 u	+/- .25	656 AD	+/-185 yrs
86-799	3.33 u	+/- .25	920 AD	+/-166 yrs
86-800	4.43 u	+/- .25	99 AD	+/-219 yrs
86-801	4.13 u	+/- .25	346 AD	+/-204 yrs
86-802	3.66 u	+/- .25	698 AD	+/-182 yrs
86-803	5.13 u	+/- .25	544 BC	+/-253 yrs
86-804	3.23 u	+/- .25	983 AD	+/-161 yrs
86-805	3.4 u	+/- .25	875 AD	+/-170 yrs
86-806	3.21 u	+/- .25	996 AD	+/-161 yrs
86-807	3.75 u	+/- .25	634 AD	+/-186 yrs
86-808	3.35 u	+/- .25	907 AD	+/-167 yrs
86-810	3.24 u	+/- .25	977 AD	+/-162 yrs
86-811	3.27 u	+/- .25	958 AD	+/-163 yrs
86-812	3.48 u	+/- .25	822 AD	+/-173 yrs
86-813	3.26 u	+/- .25	965 AD	+/-163 yrs
86-814	3.26 u	+/- .25	965 AD	+/-163 yrs
86-817	3.65 u	+/- .25	705 AD	+/-181 yrs
86-818	3.44 u	+/- .25	849 AD	+/-172 yrs
86-819	5.56 u	+/- .25	986 BC	+/-273 yrs
86-821	3.09 u	+/- .25	1068 AD	+/-154 yrs
86-822	2.68 u	+/- .25	1296 AD	+/-135 yrs
86-823	3.36 u	+/- .25	901 AD	+/-168 yrs
86-824	4.62 u	+/- .25	66 BC	+/-228 yrs
86-825	4.15 u	+/- .25	330 AD	+/-205 yrs
86-826	3.26 u	+/- .25	965 AD	+/-163 yrs
86-827	4.43 u	+/- .25	99 AD	+/-219 yrs
86-829	3.35 u	+/- .25	907 AD	+/-167 yrs
86-830	3.29 u	+/- .25	946 AD	+/-164 yrs
86-831	12.87 u	+/- .25	%13940 BC	+/-625 yrs
86-833	3.74 u	+/- .25	642 AD	+/-186 yrs
86-834	4.3 u	+/- .25	209 AD	+/-213 yrs
86-835	2.81 u	+/- .25	1227 AD	+/-141 yrs
86-837	3.96 u	+/- .25	479 AD	+/-197 yrs
86-838	3.34 u	+/- .25	914 AD	+/-167 yrs
86-839	3.35 u	+/- .25	907 AD	+/-167 yrs
86-840	3.35 u	+/- .25	907 AD	+/-167 yrs
86-841	4.07 u	+/- .25	394 AD	+/-202 yrs
86-843	3.38 u	+/- .25	888 AD	+/-169 yrs
86-844	3.12 u	+/- .25	1050 AD	+/-156 yrs
86-845	3.84 u	+/- .25	569 AD	+/-191 yrs
86-846	2.71 u	+/- .25	1280 AD	+/-136 yrs
86-847	3.46 u	+/- .25	835 AD	+/-172 yrs
86-848	5.07 u	+/- .25	485 BC	+/-250 yrs
86-851	2.15 u	+/- .25	1542 AD	+/-109 yrs
86-852	2.48 u	+/- .25	1395 AD	+/-125 yrs
86-856	4.47 u	+/- .25	65 AD	+/-221 yrs
86-857	4.61 u	+/- .25	57 BC	+/-228 yrs
86-858	4.4 u	+/- .25	125 AD	+/-218 yrs
86-867	3.15 u	+/- .25	1032 AD	+/-157 yrs
86-869	5.07 u	+/- .25	485 BC	+/-250 yrs
86-870	4.48 u	+/- .25	57 AD	+/-222 yrs
86-871	4.39 u	+/- .25	133 AD	+/-217 yrs
86-872	4.42 u	+/- .25	108 AD	+/-219 yrs
86-873	4.25 u	+/- .25	250 AD	+/-211 yrs
86-875	6.16 u	+/- .25	1662 BC	+/-302 yrs
86-876	3.3 u	+/- .25	939 AD	+/-164 yrs

Table B.2C Stevenson's Obsidian Hydration Dates for Obsidian Ridge Samples Using 11.5 um^2/1,000 Years.

Sample	Rim	S.D.	Date	S.D.
86-836	5.39 u	+/-.25	435 BC	+/-345 yrs
86-854	3.43 u	+/-.25	963 AD	+/-155 yrs
86-855	3.18	+/-.25	1104 AD	+/-141 yrs

APPENDIX C

FLOTATION ANALYSIS AT TWO MULTICOMPONENT SITES OVERLOOKING THE CHAMA RIVER VALLEY, NEAR ABIQUIU, NEW MEXICO

By

Mollie S. Toll

FLOTATION ANALYSIS AT TWO MULTI-COMPONENT SITES

OVERLOOKING THE CHAMA RIVER VALLEY, NEAR ABIQUIU, NEW MEXICO

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INTRODUCTION AND METHODS

Four flotation samples were submitted from two sites approximately a kilometer apart on slickrock uplands of the Abiquiu Reservoir. The two sites include occupations ranging from prehistoric Archaic or Puebloan through historic Piedra Lumbre and relatively recent use. As the sites were built on shallow soils, materials from the various occupations were mixed. Expectedly, preservation of cultural material was poor and recent contamination substantial. Only four carbonized seeds were recovered, and all samples contained abundant insect parts and rodent and/or insect feces. Because of the very real likelihood of intrusion of non-cultural plant material, only charred floral remains could be considered as potential economic debris.

The four soil samples collected during excavation were processed at the Mariah Associates by the simplified "bucket" version of flotation (see Bohrer and Adams 1977). Each one liter sample was immersed in a bucket of water, and a 30-40 second interval allowed for settling out of heavy particles. The solution was then poured through a fine screen (about 0.35 mm mesh) lined with a square of "chiffon" fabric, catching organic materials floating or in suspension. The fabric was lifted out and laid flat on coarse mesh screen trays, until the recovered material had dried. Each sample was sorted using a series of nested geological screens (4.0, 2.0, 1.0, 0.5 mm mesh), and then reviewed under a binocular microscope at 7-45x. The "floated" samples contained large quantities of extraneous debris, requiring long intervals of microscopic sorting time (9.0 hours in one case). As an economy measure therefore, the smallest particle size range (those items passing through the finest screen, 0.5 mm) was subsampled in Sample A2 only. The actual number of seeds of each

species recovered in this 50% subsample was used to calculate an estimated number of seeds for the total sample.

A single flotation sample (A2) contained sufficient charcoal for determination of species composition. A sample of 20 pieces of charcoal was identified (10 from the 4 mm screen, and 10 from the 2 mm screen). Each piece was snapped to expose a fresh transverse section, and identified at 45x. Low-power, incident light identification of wood specimens does not often allow species- or even genus-level precision, but can provide reliable information useful in distinguishing broad patterns of utilization of a major resource class.

RESULTS

LA 27020

Sample A1 derived from a hearth just outside a mesa edge Piedra Lumbre structure which was reoccupied sometime in the last century as a sheepherding or hunting camp. Associated with the hearth are probable Piedra Lumbre micaceous ceramics, and a carbon-14 date of BP 260 ± 60 (University of Texas #5517).

All botanical materials recovered in this sample location are unburned and appear to be modern. Present are parts of upland trees and shrubs: pinyon nutshell and cone fragments, juniper seeds (*Juniperus monosperma*), and Mormon tea inflorescences (Table 1). Weedy annuals include two genera common in prehistoric subsistence repertoires on the Colorado Plateau and in the upper Rio Grande Valley (purslane and tansymustard; Toll 1983, Struever 1979) and taxa for which potential economic uses are minor (spurge, composite family).

LA 51698

Sample A2 was taken in Structure 1, a Piedra Lumbre structure built

Table 1. Flotation Results, Abiquiu Reservoir Sites LA 27020 and LA 51698.

Taxon	LA 27020 A1 N107/E108 Lev.2	LA 27020 A2 N98/E69 Struc.1,Lev.1	LA 51698 A3 N118/E82-3 Fea.2,Lev.3	LA 51698 A4 N104/E90 Fea.3,Lev.3
WOODY PERENNIALS:				
Ephedra Mormon tea	Inflorescences			
Juniperus monosperma One-seed juniper	2/2			
Pinus edulis Pinyon	6/6 Cone fragments			
GRASSES:				
Sporobolus Dropseed		1/2		
WEEDY ANNUALS:				
Chenopodium Goosefoot		6/6*		1/1
Amaranthus Pigweed		1/2		
Portulaca Purslane	16/16	18/26		1/1
Descurainia Tansymustard	2/2			
Compositae Sunflower family	13/13			
Euphorbia Spurge	3/3			
TOTAL SEEDS				
Actual	39	26	0	2
Estimated	39	36	0	2
NUMBER OF TAXA				
All taxa	7	4	0	2
Burned taxa only	0	1	0	0

Number before slash indicates actual number of seeds recovered; number after slash indicates estimated number of seeds per liter.
* Some or all items burned.

on top of an arch-shaped dry wall construction (Puebloan or possibly Archaic). Location of this mesa bench site is notable because of proximity of a series of natural basins (tinajas) which collect and hold runoff and rain water. Four carbonized cheno-am seeds were recovered here, as well as unburned Chenopodium and Amaranthus seeds. Swelling and distortion have altered the burned seeds such that a distinction between these two genera cannot be made. However, Chenopodium and Amaranthus have similar phenology and economic use patterns (tender greens used in late spring/early summer and seeds harvested in early fall), and are both key taxa in prehistoric and historic sites throughout the region (as at San Juan Pueblo, where goosefoot, pigweed, and purslane together comprise 38% by weight --though only 3% of calories--of wild gathered food plants; Ford 1968:158). Purslane seeds are most numerous in sample A2, and dropseed grass is also present. Charcoal in this sample was entirely coniferous, and included both juniper and pinyon (Table 2).

Sample A3 was taken from a slab-lined hearth (Feature 2, Level 3) visible on the surface prior to excavation, located up the talus slope from Structure 1. Carbon-14 dates from the 11th (University of Texas #5514) and 14th (University of Texas #5508) centuries, as well as micaceous pottery, suggest that the feature was reused on multiple occasions. Though insect chitin, larval cases, and feces were abundant in this sample, flotation produced no evidence of plant utilization associated with this hearth.

Sample A4 derived from an unprepared hearth or ash dump (Feature 3, Level 3) in a sand dune. Carbon-14 and obsidian hydration dates indicate use anywhere in the range of late middle Archaic to early Tewa. Flotation materials (two unburned annual weed seeds) are undiagnostic of

Table 2. Charcoal Composition of Structure 1, Level 1, LA 51698.

Taxon	# of Pieces	% Pieces	Weight	% Weight
Juniperus Juniper	2	10%	+	+
Pinus edulis Pinyon	4	40%	0.4g	36%
Undetermined conifer	14	70%	0.7g	64%
TOTAL	20	100%	1.1g	100%

+ Less than 0.05g or 0.5%

any past subsistence use of this feature.

SUMMARY

Four flotation samples from shallow, mixed deposits at two multicomponent sites on mesas bordering the Chama River Valley contained unburned and probably intrusive floral materials from upland trees and shrubs (juniper, pinyon, Mormon tea), dropseed grass, and several weedy annuals (goosefoot, pigweed, purslane, tansymustard, sunflower family, and spurge). Charcoal and four carbonized cheno-am seeds from a multi-use hearth at LA 51698 are the only sure record of cultural activity involving plants. Firewood in this hearth was entirely coniferous, as would be expected in a zone where this preferred fuel type abounds. Both temporal and functional association of the cheno-ams is uncertain. Cheno-ams are ubiquitous in archeological assemblages throughout the region; the seeds might also represent ambient debris fortuitously burned during hearth use.

APPENDIX D

AN ANALYSIS OF POLLEN FROM ABIQUIU RESERVOIR
SITES (LA 51698, LA 27070, LA 25328), NEW MEXICO

By

Karen H. Clary

An Analysis of Pollen from Abiquiu Reservior Sites,

LA 51698, LA 27020, LA 25328)

New Mexico

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An Analysis Of Pollen From Abiquiu Reservoir Sites,

New Mexico

Four pollen samples from three archaeological sites (LA 51698, LA 25328, LA 27020) were submitted to the Castetter Laboratory for analysis. The samples were analyzed in hopes of identifying economic and environmental plant taxa from the period(s) of site occupation. As well, the analysis of pollen could yield information regarding the function of Feature 2, and economic activities that may have occurred in the context of the strata sampled.

Unfortunately, the samples were poorly preserved and were not diagnostic in regard to either prehistoric environment or the economic activities of site occupants. Relatively few pollen taxa were encountered, and the majority of pollen types were corroded and weathered. Charcoal was abundant and likely contributed to the poor preservation of pollen. It appears that the mixing of moisture from intermittent but seasonal wet cycles with charcoal/ ash in soils produced a corrosive interaction not conducive to the preservation of pollen. Taxa encountered consist of pollen types most common to the pollen record of the Southwest and that are more decay resistant relative to other pollen types. These include (Table 1) arboreal pollen taxa such as fir, spruce, Douglas-fir, pinyon, ponderosa pine, and juniper. Non-arboreal pollen taxa consist of Cheno-ams, greasewood, grasses, members of the sunflower family, and ephedra.

Table 1. Numbers of Pollen Grains Encountered in Pollen Analysis of Abiquiu Reservoir Sites, New Mexico

Sample Description / TAXON:	Pollen Numbers: Arboreal Pollen							Pollen Numbers: Non-Arboreal Pollen												Sums	
	Abies sp. (fir)	Picea sp. (spruce)	Pseudotsuga menzeisii (Douglas-fir)	Pinus sp. (pine)	Pinus edulis (pinyon)	Pinus ponderosa (ponderosa)	Juniperus sp. (juniper)	Cheno-ams (chenopod-amaranth)	Sarcobatus vermiculatus (greasewood)	Gramineae (grass family)	H.S. Compositae (high spine sunflower)	L.S. Compositae (low spine sunflower)	Artemisia sp. (sage)	Ephedra cf. trifurca (cf. Mexican tea)	Ephedra cf. viridis (cf. green ephedra)	Ephedra cf. nevadensis (cf. boundary ephedra)	Solanaceae (potato family)	Anacardiaceae (cashew family)	Unidentified	Total No. Pollen Grains	Total No. grains per gram of sediment
LA 51698. Fea. 2, Lev. 3, 118N/82-83 E. P.S. A5		1		1	4P[1]	6P							1		1	1			1	16	2286
LA 51698. Str. 1, CC/PE, 98N/169E P.S. A6	P	P		2	12P	12P	5	26	4		3									64	4109
LA 27020. Lev.2, N107/E108, P.S. A7				2P	4	7	5	4P		2									3	27	12125
LA 25328, Lev.1, N53/E29, P.S. A8	4	P	2		18P	15P	4	7X	1	1P	1	3		8			1	2	1	68	3271

[1] "P" indicates "presence" in larger fraction scan (greater than 45 microns).

POLLEN EXTRACTION

The samples were processed using a modification of the method described by Mehringer (1967).

1. A 20 gram soil sample was taken from the bag and weighed on a triple beam balance.

2. The sample was washed through a 180 micron mesh brass screen with distilled water into a 600 milliliter beaker.

3. Tablets of fresh quantified Lycopodium pollen were dissolved in each sample to serve as a control for pollen degradation or loss during the process and to calculate absolute pollen sums to determine whether or not sufficient pollen was available per sample for data interpretation (Stockmarr 1971).

4. Carbonates were removed by adding 50 mls of 40% hydrochloric acid (HCl) to each beaker. When effervescence ceased, each beaker was filled with distilled water and the sediments were allowed to settle for at least 3 hours. The water and dilute HCl were carefully poured off after settling, leaving the sediments and the pollen behind in the beaker.

5. Each beaker was filled again with distilled water, stirred, and allowed to settle for 3 hours before pouring off.

6. Beakers were filled one-third full with distilled water, stirred with clean stirring rods without creating a vortex, to suspend sediments and pollen. Three seconds after stirring stopped, the lighter soil particles and the pollen grains were poured off into a second clean beaker leaving the heavier sand particles behind in the first beaker. The procedure was repeated several times to physically separate the heavier sand from the lighter sediments and the pollen grains.

7. The sediments were transferred to 50 ml test tubes.

8. Silicates were removed by adding 50 mls of hydrofluoric acid (HF) to each beaker and placing in a hot water bath for 5 minutes. Distilled water was added twice to rinse the samples.

9. Organics were removed by the following process: The samples were rinsed with 30 mls glacial acetic acid, centrifuged and poured off. A fresh acetolysis solution was prepared, of 9 parts acetic anhydride to 1 part sulfuric acid. Thirty mls were added to each test tube, stirred, and placed in a hot water bath for 10 minutes. Tubes were removed and cooled, then centrifuged, the liquid poured off, and rinsed with glacial acetic acid, centrifuged and poured off.

10. The centrifuge tubes were filled with distilled water, stirred, centrifuged, and poured off. This was repeated twice.

11. Droplets of the pollen-bearing sediment were placed on microscope slides and mixed with glycerine jelly. A cover slip was placed on each slide and the slides were sealed with fixative.

12. The slides were examined using a Nikon microscope under magnifications of 200x, 400x, and 1000x. Pollen identification was made using Kapp's Pollen and Spores (1969), and the comparative collection of Southwestern pollen types in the Ethnobotany Lab. An attempt was made to reach a count of 200 pollen grains for each sample, to derive relative pollen frequencies for the interpretation of the pollen record (Barkley 1934).

13. The pollen was counted and the absolute pollen ratio was computed (Stockmarr 1971). The absolute pollen ratio is a ratio of fossil pollen counted to a known quantity of exotic *Eucalyptus* control pollen which has been added.

$$\text{Absolute pollen ratio (no. pollen grains/gram sediment)} = \frac{\text{No. fossil grains x No. exotics added}}{\text{No. exotics counted x No. grams/sample}}$$

14. In some cases, scant economic pollen may be missed entirely in a pollen count due to the numerical overabundance of more prolific pollen taxa or due to poor preservation. In order to ascertain the presence or absence of an important taxon, a second microscope slide preparation was made after screening the pollen residue through a 45 microns mesh screen. Pollen smaller than 45µ will pass through the screen while the larger pollen fraction remains atop the screen. The larger pollen fraction is then pipetted off and placed in glycerine jelly on a microscope slide. This method concentrates larger pollen and facilitates the encounter of scarce cultivar pollen such as maize and squash which are both larger than 45µ.

APPENDIX E

TOOL CLASSIFICATIONS

E.1 Projectile Point Classification by Bertram
E.2 Correlation of Thoms' Projectile Point Type Names and Numbers
E.3 Comparison of Bertram and Lintz Projectile Point Type Assignments
E.4 Standard Gunflint Sizes

APPENDIX E.1

Table E.1 Projectile Point Classification by Bertram.

						IF OBSIDIAN(1)					
Figure Number	Piece	Oshara Type	Thoms Type	CCP Type	Site & #	Haft Width (mm)	Haft Thickness (mm)	Rind	CRMD #	Obsidian Hydration Date	Published Date Range
8.1	A	En Medio	23?25?	T6C	25333-8	11	3.5	4.07	86-841	A.D. 100	800 B.C.-A.D. 400
	B	--	?	?	25330-12	--	--	--	86-842	No Date	?
	C	--	?	?	27020-11	--	--	3.38	86-843	A.D. 700	?
								3.12	86-844	A.D. 850	?
	D	--	?	?	27041-1	--	--	3.84	86-845	A.D. 350	?
	E	--	35	T4	27020-13	5	2.5	2.71	86-846	A.D. 1150	A.D. 400-1300
	F	--	17,21,23,25	T6D,T6A	27020-14	--	--	3.46	86-847	A.D. 575	1,500 B.C.-A.D. 1000
	G	--	16?	?	27020-12	--	--	5.07	86-848	900 B.C.	?
								--	86-849	No Date	
	H	--	>30	?	51698-1	--	--	7.29	86-850	14,000 B.C.	?
								4.29		3,200 B.C.	
	I	--	17,21,23,25	T6D,T6A	51698-7	13	5	2.15	86-851	A.D. 1450	1,000 B.C.-A.D. 1000
								2.48	86-852	A.D. 1200	
	J	--	?	?	51698-5	--	--	2.31	86-853	A.D. 400	?

Table E.1 (Continued).

						IF OBSIDIAN(1)					
Figure Number	Piece	Oshara Type	Thoms Type	CCP Type	Site & #	Haft Width (mm)	Haft Thickness (mm)	Rind	CRMD #	Obsidian Hydration Date	Published Date Range
8.2	A	--	?	T4	25480-25	--	--	--	86-832	No Date	A.D. 400-1300
	B	--	30?	?	25480-4	--	--	3.74	86-833	A.D. 300	?
	C	En Medio	?	T6	25480-3	--	--	4.3	86-834	250 B.C.	800 B.C.-A.D. 400
	D	--	?	?	25480-23	--	--	2.81	86-835	A.D. 1100	?
	E	San Jose	5,6	T7 or T13	25480-9	11	6	5.39	86-836	2,000 B.C.	5,000-1,800 B.C.
	F	--	?	?	25480-5	--	--	--	--	--	--
	G	--	13	T6(E?)	25480-6	12	5	3.96	86-837	A.D. 100	1,000 B.C.-A.D. 1000
	H	--	?	T6?	25480-13	--	--	3.34	86-838	A.D. 650	1,500 B.C.-A.D. 1000
									86-839		
	I	--	?	?	25480-10	--	--	--	--	--	--
	J	--	?	?	25480-21	--	--	3.35	86-840	A.D. 650	?
	K	--	?	?	27041-12	--	--	--	--	--	?
	L	--	?	?	25328-24	--	--	--	--	--	?

Table E.1 (Continued).

Figure Number	Piece	Oshara Type	Thoms Type	CCP Type	Site & #	IF OBSIDIAN(1) Haft Width (mm)	Haft Thickness (mm)	Rind	CRMD #	Obsidian Hydration Date	Published Date Range
8.3	A	--	?	?	51700-10	--	--	3.43	86-854	A.D. 300	?
								3.13	86-855	A.D. 700	
	B	--	8,15,20,21	T12A,T10,T6F,T8A	51700-9	15	5	4.47	86-856	400 B.C.	1,000 B.C.-A.D. 400
								4.61	86-857	600 B.C.	
	C	--	?	?	51700-6	--	--	4.4	86-858	350 B.C.	?
	D	En Medio	23,25,30,32	T6A,T6D	51700-2	9	4	--	86-859		800 B.C.-A.D. 400
								3.80	86-860	2,200 B.C.- A.D. 300	
	E	--	17,21,22,23,24,25	T6D?	25328-42	15	5	6.69,3.77	86-861	12,000- 2,200 B.C.	1,500 B.C.-A.D. 1000
								4.12,3.76	86-862	3,000- 2,200 B.C.	
	F	En Medio	14,15,20	T13,T12A,T12B,T6	25328-43	17	7	3.17	86-863	1,000 B.C.	800 B.C.-A.D. 400
								3.10	86-864	900 B.C.	
	G	--	14,15,20	T13,T12A,T12B,T6	25328-23	18	7	3.97	86-865	2,500 B.C.	4,000 B.C.-A.D. 1000
								4.07	86-866	2,800 B.C.	
	H	--	?	?	25328-7	--	--	3.15	86-867	A.D. 800	?
	I	En Medio	17,21,22,23,24,25	T6 Variant (Resharpened?)	25328-21	13	5	4.22	86-868	3,300 B.C.	800 B.C.-A.D. 400
	J	--	27?	T1?	25328-6	9	5	5.07	86-869	950 B.C.	post 500 B.C.
	K	En Medio	?	T8?	25328-19	--	--	4.48	86-870	500 B.C.	800 B.C.-A.D. 400
	L	--	11,12,13,28	T11 or T9	27042-6	10	4	4.39	86-871	200 B.C.	4,500 B.C.-A.D. 300
								4.42	86-872	300 B.C.	
	M	--	?	?	27042-2	--	--	4.25	86-873	100 B.C.	?
								--	86-874	No Date	
	N	--	11,12	T9	27042-10	17	5	6.16	86-875	2,500 B.C.	4,500 B.C.-A.D. 300
								3.30	86-876	A.D. 700	

Table F.1 (Continued).

Figure Number	Piece	Oshara Type	Thoms Type	CCP Type	Site & #	Haft Width (mm)	Haft Thickness (mm)	IF OBSIDIAN(1) Rind	CRMD #	Obsidian Hydration Date	Published Date Range
8.4	A	--	14	T6F?10??	27018-3	18	6?	3.26	86-813	A.D. 800	1,500 B.C.-A.D. 900
									86-814		
	B	--	11,28	T11	27018-12	15?	4	3.85	86-815	2,300 B.C.	4,000-500 B.C.
								4.28	86-816	3,200 B.C.	
	C	--	14,20	6F??10??	27018-28	19	7	3.65	86-817	A.D. 400	1,000 B.C.-A.D. 400
								3.44	86-818	A.D. 600	
	D	--	14,20	6F??10??	27018-26	17	7	5.56	86-819	1,500 B.C.	1,500 B.C.-A.D. 400
								--	86-820	No Date	
	E	--	14,20	6F??10??	27018-2	20	8	3.36	86-823	A.D. 700	1,000 B.C.-A.D. 700
								4.62	86-824	600 B.C.	
	F	En Medio	17,21,23,25,27	6 Generalized	27018-6	14	5	3.09	86-821	A.D. 400	800 B.C.-A.D. 400
								2.68	86-822	A.D. 1200	
	G	--	?38-42?	T1	25532-2			4.15	86-825	B.C./A.D.	post 500 B.C.
	H	--	25,23,27	6A,6C	25532-10	10.5	4	3.26	86-826	A.D. 715	1,000 B.C.-A.D. 1000
	I	En Medio	26	(A-D)	27002-2	10?	4	4.43	86-827	500 B.C.	800 B.C.-A.D. 400
				6 Generalized							
	J	--	7	(A-D)	27002-5	13?	5	4.38	86-828	3,500 B.C.	1,500 B.C.-A.D. 1000
				6 Generalized							
	K	En Medio	12 or 36/38	3 or 6A	27041-2	10	5	3.35	86-829	A.D. 750	800 B.C.-A.D. 400
								3.29	86-830		
	L	--	9,15,26	(Most Like D or F)	51703-12	16	5	Burned?	86-831	20,000 B.C.	1,500 B.C.-A.D. 900
				6 Generalized				12.87			

Table E.1 (Continued).

						IF OBSIDIAN(1)					
Figure Number	Piece	Oshara Type	Thoms Type	CCP Type	Site & #	Haft Width (mm)	Haft Thickness (mm)	Rind	CRMD #	Obsidian Hydration Date	Published Date Range
8.5	A	--	34,35	T4	25480-24	NOT OBSIDIAN(1)					
	B	--	30,32,35	T4 or T6C	25480-27	NOT OBSIDIAN					
	C	--	15,20,26	T12A or T6F	27018-15	NOT OBSIDIAN					
	D	--	15,20,26	T12A or T6F	27018-9	NOT OBSIDIAN					
	E	--	9,16	T12A,T10 T8B,T6D,T6F	27020-4	NOT OBSIDIAN					
	F	--	?	?	25328-49	NOT OBSIDIAN					
	G	--	>30	?	25328-34	NOT OBSIDIAN					
	H	--	42	T3	51701-1	NOT OBSIDIAN					
	I	--	39	Like T3 but Late Style	25333-5	NOT OBSIDIAN					
	J	--	39?	T3,T2,T6B,T10	51698-2	NOT OBSIDIAN					
	K	--	28	T11	25328-17	NOT OBSIDIAN					
	L	--	?	?	25480-28	NOT OBSIDIAN					
	M	--	<22	T9?	25328-25	NOT OBSIDIAN					
	N	--	7,9,27	T12B,T12A,T6E,T6F	51700-3	NOT OBSIDIAN					

Table E.1 (Continued).

Figure Number	Piece	Oshara Type	Thoms Type	CCP Type	Site & #	IF OBSIDIAN(1) Haft Width (mm)	Haft Thickness (mm)	Rind	CRMD #	Obsidian Hydration Date	Published Date Range
8.6	A	--	5,6	T6E,T7,T12A,T13	25328-26	NOT OBSIDIAN					
	B	--	14,15	T6A,T6F,T10	25328-22	NOT OBSIDIAN					
	C	--	28	Like T11	25333-7	NOT OBSIDIAN					
	D	--	17,21,22	T6D	25328-27	NOT OBSIDIAN					
	E	--	7,16	Like T6F	25480-18	NOT OBSIDIAN					
	F	--	29	Like T6E or T6F	25480-29	NOT OBSIDIAN					
	G	--	1 or Midland	PaleoIndian	27042-3	NOT OBSIDIAN					
	H	--	?	Untyped (T6?)	25330-6	NOT OBSIDIAN					
	I	--	22	T6D or T6F	25328-44	NOT OBSIDIAN					
	J	--	1, 2, or Jay	(T15 or PaleoIndian)	27018-16	NOT OBSIDIAN					

(1) See Appendix F or Table 8.5 for measurements on nonobsidian points.

APPENDIX E.2

Table E.2 Correlation of Thoms' Projectile Point Type Names and Numbers.[1]

Spear or Dart Points			
1.	BELEN	22.	ESPANOLA-WIDE BLADE
2.	AGATE BASIN-SERRATED BLADE	23.	ECHO-SHOULDERED
3.	MESERVE-UNBEVELED	24.	OJO-BARBED
4.	BAJADA-SUB-CONVEX	25.	SHORT-WIDE-BARBED
5.	SAN JOSE-SHORT BLADE	26.	WIDE-NOTCH-STRAIGHT BASE
6.	ARMIJO-EARED	27.	NARROW-NOTCH-CONVEX BASE
7.	EXCURVATE-STRAIGHT BASE	28.	ABIQUIU-EARED
8.	GHOST RANCH-SERRATED BLADE	29.	CHAMA BARBED
9.	EN MEDIO-PARALLEL	Arrow Points	
10.	EN MEDIO-CONTRACTING	30.	SLIGHT BARB-NARROW BASE
11.	ARROYO HONDO-SUB-CONCAVE	31.	CHIMAYO-SHOULDERED
12.	LLAVES-SUB-CONVEX	32.	LUMBRE-NARROW BASE
13.	LARGE-LATERAL-LATERAL	33.	GALLINA-NARROW BASE
14.	LAMY-WIDE TANG	34.	PARALLEL SIDED-ASYMMETRICAL TANG
15.	COCHITI-STRAIGHT BASE	35.	TESUQUE-NARROW BASE
16.	LATERAL-LATERAL-EARED	36.	POJOAQUE-WIDE BASE
17.	PINDI-CONVEX BASE	37.	PUEBLO-CONCAVE BASE
18.	AGUA FRIA-SUB-CONCAVE	38.	PUEBLO-CONVEX BASE
19.	CUNDIYO-BARBED	39.	PUEBLO-ALIGNED EDGE
20.	JEMEZ-SHORT BARB	40.	PUEBLO-BARBED
21.	SANTA CRUZ-BARBED	41.	PUEBLO-PARALLEL EDGE
		42.	PUEBLO-STRAIGHT BASE

1 From Thoms (1977:192).

APPENDIX E.3

Table E.3 Comparison of Bertram and Lintz Projectile Point Type Assignments.[1]

Site	Artifact Number	Oshara Type		Thoms Type	
		Bertram	Lintz	Bertram	Lintz
25328	24	--	--	--	--
	42	--	Arm./EM	17, 21-25	14, 17, 21-25
	43	EM	EM	14, 15, 20	19, 15
	23	--	Arm./EM	14, 15, 20	20, 15
	7	--	--	--	--
	21	EM	EM	17, 21-25	14, 21-25
	6	--	--	27?	27?, 30?
	19	EM	--	--	(19)
	49	--	--	--	--
	34	--	--	>30	--
	17	--	--	28	28
	25	--	--	<22	20?, 22?
	26	SJ/Arm.	SJ/Arm.	5, 6	6
	22	--	EM	14, 15	15
	27	--	EM	17, 21, 22	21, 22
	44	--	EM	22	21, 22
25330	12	--	--	--	(34, 35)
	6	--	--	--	15
25333	8	EM	Arm./EM	23?, 25?	23-25
	5	--	--	39	--
	7	--	--	28	--
25480	25	--	--	--	--
	4	--	SJ-EM	30?	7, 15, 21
	3	EM	EM	--	(23)
	23	--	--	--	--
	9	SJ	SJ/Arm.	5, 6	5, 6
	5	--	--	--	--
	6	--	Arm./EM	13	7, (15)
	13	--	--	--	--
	10	--	--	--	--
	21	--	(EM)	--	--
	24	--	--	34, 35	--
	27	--	EM/Trujillo	30, 32, 35	30
	28	--	--	--	--
	18	--	Arm./EM	7, 16	7, (16)
	29	--	(EM)	29	24
25532	2	--	--	38?-42?	--
	10	--	--	25, 23, 27	(23), (27)

Table E.3 (Continued).

Site	Artifact Number	Oshara Type Bertram	Oshara Type Lintz	Thoms Type Bertram	Thoms Type Lintz
27018	4	--	--	--	--
	3	--	--	14	--
	12	--	--	11, 28	(11), 28
	28	--	SJ/EM	14, 20	14, 20, 21
	26	--	Arm./EM	14, 20	14, 20, 21, 24
	6	EM	EM	17, 21, 23, 25, 27	17, 20, 24
	2	--	SJ-EM	--	14, 20, 21
	9	--	SJ-EM	15, 20, 26	(15, 20)
	15	--	SJ-EM	15, 20, 26	(15, 20)
	16	Jay	Jay	1,2	--
27020	11	--	--	--	--
	13	--	--	35	(34, 35)
	14	--	--	17, 21, 23, 25	23, 24
	12	--	--	16?	(15)
	4	--	--	9, 16	15, 14
27041	1	--	EM	--	(9), 19, 20, 24
	12	--	--	--	--
	2	EM	Arm./EM	12 or 36, 38	23, (28)
27042	6	--	--	11, 12, 13, 28	11
	2	--	Arm./EM	--	15, 14
	10	--	--	11, 12	12, (13)
	3	--	--	1 or Midland	1
27002	2	EM	--	26	--
	5	--	--	7	(20)
51700	10	--	--	--	--
	9	--	SJ-Arm.	8, 15, 20, 21	(8, 20)
	6	--	--	--	33
	2	--	(EM)	23, 25, 30, 32	23, 24
	3	--	Arm.	7, 9, 27	9
51701	1	--	--	42	39, 42
51703	12	--	--	9, 15, 26	(9), 15

Table E.3 (Continued)

	Artifact Number	Oshara Type		Thoms Type	
		Bertram	Lintz	Bertram	Lintz
[illegible]	[illegible]	--	--	>30	--
	[illegible]	--	EM	17, 21, 23, 25	17, 21, 22
	5	--	--	--	--
	[illegible]	--	--	39?	39, 36, 42

-- = not assigned to any type.
Arm. = Armijo; EM = El Medio; SJ = San Jose.
( ) = probable type.

APPENDIX E.4

Table E.4 Standard Sizes of Gun Flints based on the 1849 U.S. Army Ordnance Manual and a Sample of Measured Flints Purchased by Bannerman from U.S. Army Stores[1], Abiquiu Archaeological Study, ACOE, 1989.

		Length (mm)	Width (mm)	Thickness (mm)
Musket	U.S. Specifications:	30.5 - 38.1	27.5 - 28.7	6.6 - 8.4
	Bannerman:	27 - 35	24 - 31	5 - 11
Rifle	U.S. Specifications:	24.9 - 30.5	20.3 - 22.4	5.1 - 7.4
	Bannerman:	25 - 29	20 - 25	4 - 9
Pistol	U.S. Specifications:	23.6 - 27.7	21.3 - 23.3	5.3 - 6.9
	Bannerman:	21 - 26	18 - 22	5 - 9

1 Smith (1960:48).

APPENDIX F

TABLE OF FORMAL TOOLS

Table F.1 Formal Tools: All Sites, Abiquiu Archaeological Study, ACOE, 1989.

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
25328	30	1	148.00	60.00	0	0	1	3530.00	bif-lpre	frag	0	incomp	0	none	0	0	0	37	12	4
25328	50	1	149.00	60.00	0	0	2	2205.00	bif-blnk	whole	0	incomp	0	none	0	0	0	58	45	13
25328	55	1	152.00	61.00	0	0	3	3530.00	biface	frag	0	complt	0	none	0	0	0	14	11	2
25328	91	2	105.00	125.00	0	0	4	3530.00	bif-blnk	frag	0	incomp	0	none	0	0	0	40	31	9
25328	301	3	58.35	144.20	0	0	8	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	32	20	5
25328	321	3	60.00	147.00	0	0	50	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	19	10	4
25328	321	3	60.00	147.00	0	0	52	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	30	18	8
25328	330	3	62.00	143.00	0	0	9	1.00	endscr	whole	10	complt	0	none	0	0	0	33	26	9
25328	334	3	61.00	146.00	0	0	53	1.04	bif-blnk	frag	10	incomp	0	none	0	0	0	42	24	10
25328	343	3	58.00	151.00	0	0	61	1112.00	bif-epre	frag	0	incomp	0	none	0	0	0	28	25	6
25328	345	3	60.00	153.00	0	0	11	3530.00	bif-lpre	frag	0	incomp	0	none	0	0	0	15	11	2
25328	381	3	52.00	152.00	0	0	55	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	15	14	3
25328	386	3	55.00	150.00	0	0	13	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	28	21	5
25328	390	3	57.00	152.00	0	0	14	1.02	uniface	frag	0	complt	0	none	0	0	0	29	21	12
25328	399	3	50.00	157.00	0	0	58	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	23	19	9
25328	412	3	61.00	153.00	0	0	59	1.04	bif-epre	frag	10	incomp	0	none	0	0	0	25	13	7
25328	414	3	60.00	153.00	0	0	15	1.04	bif-lpre	frag	0	incomp	0	none	0	1	0	39	14	3
25328	417	3	51.00	154.00	0	0	60	1.00	bif-blnk	frag	10	incomp	0	none	0	0	0	40	17	11
25328	422	3	55.00	154.00	0	0	16	3520.00	endscr	whole	0	complt	0	none	0	0	0	39	27	12
25328	430	3	52.99	152.03	0	0	17	1.01	bif/point	frag	0	indet	25	none	0	0	10	33	15	4
25328	432	3	58.00	152.00	0	0	62	3530.00	biface	frag	0	complt	0	none	0	0	0	23	15	4
25328	449	3	60.00	152.00	0	0	18	1.03	bif-epre	lateral	0	incomp	0	none	0	0	0	28	16	6
25328	450	3	54.46	153.81	0	0	19	3530.00	bif/point	basalfrg	0	indet	20	none	0	0	12	24	30	5

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
25328	451	3	56.00	153.00	0	0	63	3530.00	bif-lpre	frag	0	incomp	0	none	0	0	0	20	15	7
25328	453	3	51.00	153.00	0	0	20	1.04	biface	frag	0	complt	0	none	0	0	0	26	16	4
25328	821	3	55.15	145.50	0	0	45	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	36	22	7
25328	196	4	44.48	96.18	0	0	6	3530.00	bif/point	frag	0	complt	56	none	0	0	8	24	13	5
25328	241	4	43.90	59.10	0	0	5	1.04	bif/drill	tip	0	complt	0	none	0	0	0	23	12	7
25328	248	4	42.27	92.93	0	0	7	3530.00	bif/point	basalfrg	0	incomp	26	none	0	0	14	17	19	6
25328	274	4	41.00	85.00	0	0	47	1.03	uniface	frag	5	incomp	0	none	0	0	0	36	22	16
25328	464	5	80.00	101.00	0	0	29	1.03	bif-lpre	frag	0	incomp	0	none	0	0	0	25	20	5
25328	497	5	81.80	104.10	0	0	30	1.02	bif-lpre	frag	0	incomp	0	none	0	0	0	31	24	3
25328	506	5	83.50	102.40	0	0	31	1.00	bif-epre	frag	0	incomp	0	none	0	0	0	33	47	10
25328	536	5	82.00	113.00	0	0	48	2200.00	bif-epre	frag	0	incomp	0	none	0	0	0	40	17	6
25328	579	5	87.00	101.00	0	0	49	2205.00	bif/point	basalsnp	0	indet	38	none	0	0	16	14	19	4
25328	580	5	87.00	107.00	0	0	51	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	20	11	8
25328	581	5	87.00	103.00	0	0	56	1.04	bif-lpre	frag	0	incomp	0	none	0	0	0	33	18	10
25328	586	5	87.00	108.00	0	0	32	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	27	26	7
25328	588	5	86.00	107.00	0	0	33	1.00	biface	frag	0	complt	0	none	0	0	0	45	30	16
25328	596	5	86.05	114.10	0	0	34	2205.00	bif/point	midsect	0	complt	50	none	0	0	12	23	13	4
25328	599	5	86.00	118.00	0	0	35	2205.00	ret-uni	whole	0	complt	0	none	0	0	0	59	46	31
25328	610	5	88.00	102.00	0	0	36	2200.00	bif-epre	frag	10	incomp	0	none	0	0	0	59	40	10
25328	638	5	88.00	112.00	0	0	57	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	32	13	5

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
25328	685	5	92.00	101.00	0	0	37	2200.00	bif-lpre	frag	0	incomp	0	none	0	0	0	41	41	7
25328	685	5	92.00	101.00	0	0	39	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	35	28	7
25328	688	5	93.00	101.00	0	0	38	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	50	43	9
25328	709	5	94.00	104.00	0	0	40	1.00	bif-lpre	frag	0	incomp	0	none	0	0	0	24	20	6
25328	710	5	94.00	100.00	0	0	41	2205.00	biface	frag	0	complt	0	none	0	0	0	32	25	4
25328	731	5	95.00	113.00	0	0	54	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	15	12	6
25328	816	5	81.88	99.75	0	0	43	3530.00	bif/point	basalsnp	0	complt	32	none	0	0	17	12	19	6
25328	817	5	88.35	98.65	0	0	44	2205.00	bif/point	basalfrg	0	complt	66	none	0	0	20	22	36	6
25328	823	5	88.00	101.00	0	0	46	2205.00	biface	frag	0	complt	0	none	0	0	0	36	28	5
25328	683	6	53.00	129.00	1	0	28	3520.00	uniface	frag	0	complt	0	none	0	0	0	50	27	12
25328	456	9	0.00	0.00	0	0	21	3530.00	bif/point	frag	0	complt	0	none	0	0	13	22	17	4
25328	457	9	0.00	0.00	0	0	22	3700.00	bif/point	frag	0	indet	26	none	0	0	13	23	23	7
25328	458	9	0.00	0.00	0	0	23	3520.00	bif/point	basalsnp	0	complt	0	none	0	0	18	10	21	6
25328	459	9	0.00	0.00	0	0	24	3530.00	bif/poin	frag	0	complt	32	none	0	0	0	20	20	3
25328	460	9	0.00	0.00	0	0	25	1.01	bif/point	frag	0	complt	20	none	0	0	0	28	18	4
25328	461	9	0.00	0.00	0	0	26	1.01	bif/point	frag	0	complt	38	none	0	0	12	22	16	6
25328	462	9	0.00	0.00	0	0	27	1.01	bif/point	basalfrg	0	complt	26	none	0	0	0	21	23	7
25328	815	9	69.70	89.40	0	0	42	3520.00	bif/point	basalsnp	0	complt	38	none	0	0	14	10	20	4
25330	12	1	121.00	114.00	0	0	1	1.03	bif-lpre	frag	0	complt	0	batt	0	2	0	49	40	8
25330	17	1	101.00	109.00	0	0	25	1.04	bif-blnk	frag	0	incomp	0	none	0	0	0	48	18	5
25330	27	1	102.00	102.00	0	0	7	2205.04	bif/drill	tip	0	complt	0	none	0	0	0	29	10	5

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
25330	30	1	102.00	105.00	0	0	26	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	18	17	2
25330	33	1	102.00	109.00	0	0	27	1.03	bif-blnk	frag	0	incomp	0	none	0	0	0	48	32	11
25330	33	1	102.00	109.00	0	0	8	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	42	30	6
25330	48	1	100.00	118.00	0	0	28	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	32	16	7
25330	49	1	100.00	118.00	0	0	9	1.04	uniface	frag	0	incomp	0	none	0	0	0	30	22	8
25330	50	1	103.00	100.00	0	0	10	3530.00	uniface	whole	10	incomp	0	none	0	0	0	33	27	15
25330	55	1	103.00	106.00	0	0	11	1.03	bif-blnk	frag	0	incomp	0	none	0	0	0	50	33	18
25330	62	1	103.00	117.00	0	0	29	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	18	16	4
25330	64	1	103.53	106.25	0	0	12	3520.00	bif/point	basalfrg	0	indet	50	none	0	0	6	10	10	2
25330	71	1	104.00	104.00	0	0	13	1.00	bif-blnk	frag	0	incomp	0	none	0	0	0	42	30	10
25330	89	1	105.00	104.00	0	0	36	3530.00	bif-lpre	frag	0	incomp	0	none	0	0	0	11	4	2
25330	98	1	105.00	118.00	0	0	30	2205.00	bif-epre	frag	0	incomp	0	none	0	0	0	18	10	4
25330	111	1	106.00	107.00	0	0	14	3530.00	ret-uni	whole	0	complt	0	none	0	0	0	31	30	13
25330	120	1	106.00	118.00	0	0	15	1.02	biface	frag	0	complt	0	none	0	0	0	35	17	6
25330	138	1	107.00	112.00	0	0	18	1.03	uniface	frag	0	incomp	0	none	0	0	0	32	18	11
25330	164	1	108.00	115.00	0	0	31	3530.00	uniface	frag	0	incomp	0	none	0	0	0	40	18	8
25330	185	1	109.59	109.14	0	0	19	1014.03	endscr	whole	0	complt	0	none	0	0	0	55	50	13
25330	187	1	109.26	108.51	0	0	20	1.00	uniface	whole	0	complt	0	none	0	0	0	75	72	26
25330	232	1	111.47	116.85	0	0	21	1.03	endscr	whole	0	complt	0	none	0	0	0	35	27	7
25330	256	1	113.00	127.00	0	0	32	1.00	bif-epre	frag	0	incomp	0	none	0	0	0	13	5	3
25330	301	1	116.00	120.00	0	0	33	1.03	uniface	frag	0	incomp	0	none	0	0	0	18	7	3

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
25330	330	1	117.00	119.00	0	0	22	1.03	bif-epre	lateral	0	incomp	0	none	0	0	0	32	17	5
25330	388	1	120.00	127.00	0	0	23	1413.04	uniface	frag	0	complt	0	none	0	0	0	27	21	6
25330	477	1	125.00	107.00	0	0	34	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	42	15	10
25330	563	1	129.00	108.00	0	0	35	1.00	bif-blnk	frag	0	incomp	0	none	0	0	0	45	20	12
25330	589	2	110.00	97.00	0	0	24	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	18	15	5
25330	591	2	110.00	99.00	0	0	4	3530.00	bif-lpre	frag	0	incomp	0	none	0	0	0	17	9	3
25330	641	2	114.00	94.00	0	0	1	1.00	bif-epre	frag	0	incomp	0	none	0	0	0	71	30	13
25330	664	2	116.00	94.84	0	0	2	1.00	endscr	whole	10	complt	0	none	0	0	0	63	55	12
25330	702	9	123.00	142.00	0	0	5	1.00	uniface	whole	0	complt	0	none	0	0	0	72	56	21
25330	703	9	89.00	126.00	0	0	6	1.01	bif/point	whole	10	indet	20	none	0	1	17	28	25	4
25333	1	1	[illegible]1.90	123.90	0	0	5	1.01	bif/point	frag	0	complt	54	none	0	0	7	25	13	3
25333	32	1	104.00	118.00	0	0	1	3530.00	uniface	frag	0	incomp	0	none	0	0	0	43	25	14
25333	71	1	112.00	119.00	0	0	2	1.00	uniface	whole	40	incomp	0	none	0	0	0	71	45	24
25333	72	1	113.00	116.00	0	0	3	1021.00	uniface	frag	0	incomp	0	none	0	0	0	81	45	26
25333	80	1	130.00	129.00	0	0	4	3530.00	ret-bi	whole	0	comolt	0	none	0	0	0	26	18	5
25333	101	1	137.00	120.00	0	0	6	3520.00	bif/point	basalsnp	0	complt	0	none	0	0	0	6	18	4
25333	132	9	0.00	0.00	0	0	7	1.01	bif/point	frag	0	indet	25	none	0	0	0	32	14	4
25333	134	9	0.00	0.00	0	0	8	3530.00	bif/point	basalfrg	0	complt	46	none	0	0	11	10	16	4
25480	564	1	407.00	330.00	0	0	15	1.02	bif-epre	lateral	0	incomp	0	none	0	0	0	20	17	7
25480	570	1	414.00	330.00	0	0	16	1142.02	bif-epre	frag	0	incomp	0	none	0	0	0	35	30	8
25480	580	1	392.00	331.00	0	0	38	3530.00	uniface	frag	0	incomp	0	none	0	0	0	18	11	4

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
25480	585	1	397.00	331.00	0	0	17	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	19	15	4
25480	596	1	407.20	331.74	0	0	18	2205.00	bif/point	basalfrg	0	complt	44	none	0	0	18	22	23	4
25480	615	1	394.00	332.00	0	0	19	1.02	uniface	whole	0	complt	0	none	0	0	0	49	35	18
25480	645	1	399.30	333.85	0	0	20	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	39	36	12
25480	660	1	418.00	333.00	0	0	39	3530.00	bif-blnk	frag	0	incomp	0	none	0	0	0	45	18	8
25480	670	1	398.00	334.00	0	0	40	3530.00	uniface	frag	0	complt	0	none	0	0	0	32	16	6
25480	680	1	413.50	334.40	0	0	21	3530.00	bif/point	frag	0	incomp	25	none	0	0	18	21	23	7
25480	704	1	412.00	335.00	0	0	22	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	28	11	0
25480	714	1	392.00	336.00	0	0	23	3530.00	bif/point	basalfrg	0	indet	0	none	0	0	9	18	13	3
25480	763	1	390.00	338.00	0	0	24	1.03	bif/point	tip	0	incomp	56	none	0	1	4	14	9	3
25480	794	1	419.00	339.00	0	0	25	3530.00	bif/point	basalfrg	0	incomp	0	none	0	0	0	7	14	3
25480	802	1	420.00	329.40	0	0	26	2205.00	bif-epre	frag	0	incomp	0	none	0	0	0	55	40	11
25480	82	2	396.00	320.00	0	0	32	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	16	11	3
25480	92	2	394.00	302.00	0	0	1	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	34	24	8
25480	135	2	393.00	301.00	0	0	33	3520.00	uniface	frag	0	incomp	0	none	0	0	0	25	10	4
25480	135	2	393.00	301.00	0	0	2	1.03	bif/drill	basalfrg	0	complt	0	none	0	0	6	18	19	2
25480	135	2	393.00	301.00	0	0	2	1.04	bif/drill	basalfrg	0	complt	0	none	0	0	0	18	19	3
25480	138	2	393.00	304.00	0	0	34	1.00	uniface	frag	0	complt	0	none	0	0	0	23	19	6
25480	187	2	391.00	304.00	0	0	35	1.03	bif-blnk	frag	0	incomp	0	none	0	0	0	22	10	8
25480	192	2	390.80	303.80	0	0	3	3530.00	bif/point	basalfrg	0	incomp	40	none	0	0	9	15	15	4
25480	218	2	391.00	326.00	0	0	4	3530.00	bif/point	basalsnp	0	complt	30	none	0	0	0	7	13	4

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
25480	801	2	394.00	300.00	1	0	30	1.04	bif/drill	basalfrg	0	indet	0	none	0	0	8	21	16	2
25480	271	3	386.65	311.20	0	0	6	3530.00	bif/point	whole	0	complt	30	none	0	0	12	23	18	5
25480	340	3	377.00	307.00	0	0	7	1.04	bif-blnk	frag	0	incomp	0	none	0	0	0	41	23	9
25480	355	3	376.00	309.00	0	0	36	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	24	22	7
25480	363	3	375.00	303.00	0	0	8	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	21	15	5
25480	379	3	372.37	304.38	0	0	9	3530.00	bif/point	basalfrg	0	complt	17	none	0	0	10	18	16	5
25480	381	3	372.00	302.00	0	0	37	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	20	6	4
25480	410	3	368.00	305.00	0	0	10	3520.00	bif-point	frag	0	incomp	0	none	0	0	0	28	15	3
25480	450	3	360.00	307.00	0	0	11	1231.03	bif-epre	frag	0	incomp	0	none	0	0	0	21	13	6
25480	514	4	364.00	298.00	0	0	12	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	32	25	6
25480	515	4	364.90	299.40	0	0	13	3530.00	bif/point	frag	0	complt	56	none	0	0	0	20	16	3
25480	539	4	367.00	285.00	0	0	14	1630.03	biface	frag	0	complt	0	none	0	0	0	10	12	2
25480	546	4	369.00	281.00	0	0	31	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	26	18	9
25480	233	9	394.54	331.88	0	0	5	3530.00	bif/point	frag	0	complt	0	none	0	0	0	19	15	2
25480	803	9	382.00	283.00	0	0	27	1.03	bif/point	basalfrg	0	complt	56	none	0	0	7	20	13	3
25480	804	9	356.00	271.00	0	0	28	2200.00	bif/point	midsect	0	complt	20	none	0	0	0	21	19	5
25480	805	9	433.00	278.00	0	0	29	1.01	bif/point	basalfrg	0	complt	26	none	0	0	14	25	20	3
25532	32	1	123.00	101.00	0	0	12	3530.00	bif-blnk	frag	0	incomp	0	none	0	0	0	36	20	7
25532	36	1	124.00	109.00	0	0	13	3530.00	bif-epre	frag	40	incomp	0	none	0	0	0	48	34	8
25532	53	1	126.00	102.00	0	0	2	3530.00	bif/point	basalfrg	0	complt	50	none	0	0	0	12	13	2
25532	83	1	128.00	107.00	0	0	14	3530.00	ret-uni	whole	0	incomp	0	none	0	0	0	32	25	10

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
25532	85	1	128.00	108.00	0	0	3	3530.00	bif/drill	basalfrg	0	indet	0	none	0	0	0	21	19	4
25532	88	1	129.00	105.00	0	0	4	1.04	biface	frag	0	incomp	0	none	0	0	0	14	8	3
25532	96	1	129.00	113.00	0	0	15	3530.00	ret-bi	whole	0	incomp	0	none	0	0	0	26	18	6
25532	102	2	114.00	125.00	0	0	5	3530.00	bif-blnk	frag	0	incomp	0	none	0	0	0	42	22	12
25532	116	2	117.00	127.00	0	0	6	1.03	biface	midsect	0	complt	0	none	0	0	0	13	20	3
25532	132	2	109.00	128.00	0	0	17	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	40	36	7
25532	132	2	109.00	128.00	0	0	16	3530.00	bif-blnk	frag	0	complt	0	none	0	0	0	10	4	2
25532	142	2	106.00	125.00	0	0	7	1.03	bif-lpre	frag	0	incomp	0	none	0	0	0	30	19	8
25532	149	2	117.00	126.00	0	0	18	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	35	21	7
25532	151	2	118.00	126.00	0	0	19	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	22	17	9
25532	182	2	104.00	132.00	0	0	8	3530.00	bif-lpre	frag	0	incomp	0	none	0	0	0	19	11	3
25532	188	2	118.00	129.00	0	0	9	3530.00	bif/drill	whole	0	indet	0	none	0	0	0	26	26	5
25532	192	2	105.25	129.75	0	0	10	3530.00	bif/point	basalsnp	0	complt	6	none	0	0	11	13	16	4
25532	200	2	105.00	131.00	0	0	28	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	20	15	5
25532	209	2	110.00	131.00	0	0	20	1.03	ret-uni	frag	10	incomp	0	none	0	0	0	57	53	17
25532	217	2	118.00	131.00	0	0	29	3530.00	bif-lpre	frag	0	incomp	0	none	0	0	0	17	11	3
25532	219	2	119.00	133.00	0	0	22	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	22	17	4
25532	245	2	109.00	123.00	0	0	23	1.02	bif-epre	midsect	0	incomp	0	none	0	0	0	28	22	6
25532	246	2	110.00	123.00	0	0	24	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	27	20	10
25532	250	2	107.00	123.00	0	0	25	1.03	bif-epre	frag	10	incomp	0	none	0	0	0	29	28	15
25532	254	2	117.00	124.00	0	0	26	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	40	25	8

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
25532	256	2	116.00	124.00	0	0	27	1.04	bif-lpre	frag	0	incomp	0	none	0	0	0	34	14	4
25532	278	2	107.00	122.00	0	0	11	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	29	14	6
27002	2	1	129.00	112.00	0	0	6	3530.30	uniface	frag	0	incomp	0	none	0	0	0	29	12	5
27002	9	1	128.00	112.00	0	0	1	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	28	23	7
27002	22	1	129.90	116.30	0	0	2	3530.00	bif/point	basalsnp	0	complt	0	none	0	0	11	9	15	4
27002	52	1	124.00	119.00	0	0	7	3530.00	uniface	frag	0	complt	0	none	0	0	0	23	18	7
27002	56	1	124.00	103.00	0	0	3	1.02	bif-lpre	frag	0	incomp	0	none	0	0	0	17	15	3
27002	69	1	124.00	113.00	0	0	8	1.04	bif-epre	lateral	0	incomp	0	none	0	0	0	20	17	5
27002	75	1	125.00	111.00	0	0	9	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	21	10	5
27002	83	1	123.00	116.00	0	0	4	3530.00	bif-lpre	frag	0	incomp	0	none	0	0	0	20	12	2
27002	109	1	113.95	102.23	0	0	5	3520.00	bif/point	basalsnp	0	complt	0	none	0	0	13	12	19	4
27004	2	1	98.00	106.00	0	0	8	1.04	thumbscr	whole	40	complt	0	none	0	0	0	25	17	7
27004	13	1	98.00	119.00	0	0	1	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	48	22	10
27004	34	1	94.00	129.00	0	0	5	1.03	bif-blnk	frag	10	incomp	0	none	0	0	0	33	30	12
27004	38	1	95.00	121.00	0	0	6	1.03	bif-lpre	lateral	0	incomp	0	none	0	0	0	16	10	3
27004	39	1	95.00	120.00	0	0	2	1.04	bif-lpre	frag	0	incomp	0	none	0	0	0	34	22	5
27004	51	1	91.00	112.00	0	0	3	1.00	bif-blnk	frag	80	incomp	0	none	0	0	0	55	48	15
27004	58	1	74.00	103.00	0	0	4	2200.00	bif-epre	frag	0	incomp	0	none	0	0	0	18	26	5
27004	94	1	75.00	111.00	0	0	7	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	40	22	8
27018	17	1	100.00	160.00	0	0	1	3700.00	bif-blnk	whole	0	incomp	0	none	0	0	0	75	48	17
27018	40	1	102.00	186.00	0	0	39	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	31	8	7

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
27018	103	1	106.00	165.00	0	0	41	1.02	ret-uni	frag	10	incomp	0	none	0	0	0	22	15	8
27018	103	1	106.00	165.00	0	0	40	1.03	bif-blnk	frag	0	incomp	0	none	0	0	0	70	46	16
27018	110	1	111.40	170.90	0	0	2	3530.00	bif/point	basalsnp	0	complt	32	none	0	0	20	18	24	8
27018	110	1	111.40	170.90	0	0	3	3530.00	bif/point	frag	0	incomp	32	none	0	0	0	22	14	5
27018	134	1	98.00	58.60	0	0	4	3530.00	bif/point	basalfrg	0	incomp	0	none	0	0	14	18	18	4
27018	139	1	101.00	151.00	0	0	31	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	43	28	11
27018	232	1	107.00	102.00	0	0	29	1.04	bif-epre	frag	0	incomp	32	none	0	0	0	43	38	11
27018	247	1	106.00	108.00	0	0	5	1.03	bif/drill	tip	0	incomp	0	none	0	0	0	42	22	6
27018	254	1	106.00	121.00	0	0	36	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	12	6	3
27018	261	1	107.00	104.00	0	0	33	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	27	18	5
27018	266	1	107.00	129.00	0	0	32	1.03	biface	frag	0	complt	0	none	0	0	0	12	9	1
27018	284	1	106.90	117.18	0	0	6	3530.00	bif/point	basalfrg	0	complt	26	none	0	0	12	18	23	4
27018	289	1	104.00	109.00	0	0	42	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	40	13	8
27018	289	1	104.00	109.00	0	0	43	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	12	5	2
27018	318	1	105.00	109.00	0	0	44	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	21	14	3
27018	322	1	102.00	106.00	0	0	45	1.04	biface	frag	0	complt	0	none	0	0	0	22	20	4
27018	326	1	103.00	107.00	0	0	7	1.01	biface	frag	0	complt	0	none	0	0	0	30	24	4
27018	328	1	103.00	108.00	0	0	46	1112.03	ret-uni	frag	40	complt	0	none	0	0	0	49	34	8
27018	329	1	103.00	106.00	0	0	47	3530.00	bif-blnk	frag	0	incomp	0	none	0	0	0	30	9	7
27018	349	1	102.00	100.00	0	0	48	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	17	8	4
27018	350	1	102.00	110.00	0	0	49	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	24	11	8

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
27018	351	1	102.00	113.00	0	0	8	2205.00	bif-epre	frag	0	incomp	0	none	0	0	0	35	36	6
27018	361	1	103.00	110.00	0	0	17	2205.00	bif-epre	frag	0	incomp	0	none	0	0	0	45	38	10
27018	371	1	100.00	109.00	0	0	9	1.01	bif/point	basalsnp	0	complt	32	none	0	0	17	10	20	5
27018	381	1	101.00	116.00	0	0	30	1.03	biface	frag	0	complt	0	none	0	0	0	26	18	5
27018	389	1	100.00	122.00	0	0	10	3530.00	bif/point	frag	0	complt	0	none	0	0	0	20	14	6
[illegible]18	390	1	101.00	128.00	0	0	11	1400.00	bif-epre	whole	0	incomp	0	none	0	1	0	40	25	5
27018	401	1	99.60	123.95	0	0	12	3530.00	bif/point	basalfrg	0	complt	25	none	0	0	17	13	23	4
27018	404	1	100.00	110.00	0	0	13	1.03	biface	whole	0	complt	0	none	0	0	0	47	38	14
27018	406	1	100.00	112.00	0	0	14	2200.00	bif-blnk	frag	0	incomp	0	none	0	0	0	40	34	11
27018	407	1	100.00	113.00	0	0	15	1.03	bif/point	basalsnp	0	complt	26	none	0	0	0	10	17	5
27018	419	1	149.85	14.30	0	0	16	1.04	bif/point	basalfrg	0	complt	11	none	0	0	17	48	21	8
27018	571	1	106.00	124.10	0	0	26	3530.00	bif/point	basalsnp	0	complt	32	none	0	0	17	18	21	7
27018	572	1	107.70	122.90	0	0	27	1400.03	bif-lpre	midsect	0	incomp	0	none	0	0	0	16	19	4
27018	576	1	105.10	126.00	0	0	28	3530.00	bif/point	basalsnp	0	complt	0	none	0	0	19	13	24	6
27018	429	2	146.00	1[illegible].00	0	0	35	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	13	13	5
27018	456	2	134.00	6.00	0	0	18	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	43	24	11
27018	465	2	138.00	7.00	0	0	34	1.00	uniface	frag	5	incomp	0	none	0	0	0	42	31	8
27018	471	2	126.00	7.00	0	0	19	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	[illegible]5	30	11
27018	479	2	145.00	7.00	0	0	20	3530.00	bif-blnk	frag	0	incomp	0	none	0	0	0	4[illegible]	26	12
27018	487	2	136.00	6.00	0	0	21	1.03	bif-blnk	frag	0	incomp	0	none	0	0	0	54	35	11
27018	489	2	135.00	5.00	0	0	22	1.00	bif-blnk	frag	0	incomp	0	none	0	0	0	57	50	18

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
27018	493	2	136.00	5.00	0	0	50	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	25	6	5
27018	510	2	134.00	1.00	0	0	38	1.02	b.f-epre	frag	0	incomp	0	none	0	0	0	36	27	10
27018	519	2	138.00	0.00	0	0	23	1.02	uniface	frag	0	incomp	0	none	0	0	0	33	23	12
27018	531	2	135.00	1.00	0	0	37	1.03	bif-lpre	frag	0	incomp	0	none	0	0	0	11	8	3
27018	534	2	144.00	1.00	0	0	24	1021.04	bif-blnk	frag	0	incomp	0	none	0	0	0	64	41	11
27018	563	2	141.00	2.00	0	0	25	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	43	25	6
27020	5	1	108.00	118.00	0	0	1	1.03	bif-epre	lateral	0	incomp	0	none	0	0	0	46	38	11
27020	9	1	105.00	119.00	0	0	15	1.03	bif/drill	[illegible]	0	indent	0	none	0	0	0	32	14	3
27020	32	1	114.00	110.00	0	0	2	1.00	uniface	[illegible]	0	complt	0	none	0	0	0	33	31	15
27020	63	1	111.00	112.00	0	0	6	1.00	[illegible]	frag	0	incomp	0	none	0	0	0	47	33	13
27020	91	1	105.00	104.00	0	0	3	[illegible]	[illegible]	frag	0	incomp	0	none	0	0	0	37	35	4
27020	92	1	117.65	102.07	0	0	4	[illegible]	bif/point	basalsnp	0	complt	12	none	0	0	14	13	16	6
27020	108	1	106.85	103.05	0	0	[illegible]	[illegible]	bif/point	frag	0	incomp	50	none	0	0	6	19	14	3
27020	109	1	103.00	104.00	0	0	[illegible]	1.04	biface	frag	0	complt	0	none	0	0	0	13	7	2
27020	130	1	111.30	109.00	0	0	6	1.03	ret-uni	frag	20	incomp	0	none	0	0	0	47	29	9
27020	155	1	102.00	[illegible]	0	0	7	2205.00	bif-epre	frag	0	incomp	0	none	0	0	0	53	29	6
27020	211	1	[illegible]	[illegible]	0	0	8	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	32	32	9
27020	212	1	[illegible]	[illegible]	0	0	9	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	22	15	3
27020	217	1	[illegible]	129.00	0	0	10	1.03	ret-uni	whole	0	complt	0	none	0	0	0	42	28	12
27020	243	1	120.00	115.00	0	0	12	3530.00	bif/point	frag	0	incomp	32	none	0	0	20	27	22	8
27020	[illegible]	1	120.00	123.00	0	0	13	3530.00	bif/point	whole	0	complt	56	none	0	0	3	22	12	3

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
27020	245	1	100.00	145.00	0	0	14	3530.00	bif/point	whole	0	complt	26	none	0	0	12	24	21	5
27020	14	1	118.00	117.00	0	0	7	3530.00	uniface	whole	0	incomp	0	none	0	0	0	18	15	5
27041	52	1	121.00	113.00	0	0	26	1.02	bif-epre	whole	0	incomp	0	none	0	0	0	37	34	12
27041	55	1	124.65	112.92	0	0	8	1.02	biface	frag	0	complt	0	none	0	0	0	22	16	3
27041	61	1	126.00	112.00	0	0	3	1.03	biface	frag	0	complt	0	none	0	0	0	26	22	5
27041	62	1	128.00	112.00	0	0	4	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	31	22	7
27041	71	1	128.00	113.00	0	0	5	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	34	47	9
27041	76	1	126.10	112.75	0	0	9	1.04	biface	frag	0	complt	0	none	0	0	0	26	38	5
27041	94	1	128.00	114.00	0	0	6	1.02	bif-epre	lateral	0	incomp	0	none	0	0	0	36	16	5
27041	95	1	129.98	114.51	0	0	2	3530.00	bif/point	whole	0	incomp	54	none	0	0	9	27	14	4
27041	99	1	124.00	108.00	0	0	12	3530.00	bif/point	frag	0	incomp	0	none	0	0	0	15	15	3
27041	103	1	125.00	109.00	0	0	21	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	25	20	4
27041	104	1	125.00	108.00	0	0	20	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	30	30	4
27041	106	1	129.00	110.00	0	0	19	3530.00	uniface	frag	0	incomp	0	none	0	0	0	30	14	9
27041	107	1	128.00	110.00	0	0	18	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	18	3	3
27041	110	1	127.00	111.00	0	0	15	3400.00	biface	frag	0	complt	0	none	0	0	0	25	18	4
27041	116	1	123.00	111.00	0	0	22	1.03	biface	frag	0	complt	0	none	0	0	0	7	7	1
27041	116	1	123.00	111.00	0	0	13	3530.00	uniface	whole	0	incomp	0	none	0	0	0	32	25	7
27041	127	1	129.00	106.00	0	0	25	2205.00	uniface	frag	0	incomp	0	none	0	0	0	32	12	9
27041	142	1	126.83	108.24	0	0	10	1.01	bif-blnk	frag	0	complt	0	none	0	0	0	22	17	3
27041	143	1	129.00	105.00	0	0	17	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	26	13	9

Table F.1 (Continued).

Site	Arti-fact Lot	Unit	North	East	Fea-ture	Level	Arti-fact No.	Mate-rial(1)	Tool(2) Type	Por-tion(3)	Cor-tex(4)	Complt (5)	Func-tional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
27041	143	1	129.00	105.00	0	0	23	1.04	bif-blnk	frag	0	incomp	0	none	0	0	0	35	23	10
27041	159	1	115.00	103.00	0	0	14	1.03	ret-uni	whole	20	complt	0	none	0	0	0	55	47	15
27041	178	1	120.00	104.15	0	0	11	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	35	25	8
27041	184	1	129.10	101.80	0	0	1	3530.00	bif/point	frag	0	complt	0	none	0	0	8	17	18	6
27042	3	1	303.00	336.00	0	0	1	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	21	12	4
27042	12	1	305.00	338.00	0	0	2	3530.00	bif/point	basalfrg	0	incomp	24	none	0	0	17	29	20	7
27042	38	1	313.00	333.00	0	0	1	1.02	bif-blnk	frag	0	incomp	0	none	0	0	0	22	18	6
27042	50	3	297.00	301.00	0	0	4	3530.00	ret-bi	frag	0	incomp	0	none	0	0	0	35	22	7
27042	67	3	274.00	301.00	0	0	5	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	37	31	7
27042	79	3	363.00	300.00	0	0	6	3530.00	bif/point	whole	0	complt	25	none	0	0	9	33	22	5
27042	97	4	309.00	286.00	0	0	12	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	32	14	9
27042	103	4	309.00	290.00	0	0	13	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	25	13	6
27042	43	9	331.00	309.00	0	0	3	1.03	bif/point	basalfrg	0	complt	11	none	0	0	18	28	19	6
27042	114	9	305.00	299.00	0	0	7	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	20	19	5
27042	115	9	301.50	299.00	0	0	8	3530.00	bif-blnk	frag	0	incomp	0	none	0	0	0	33	21	8
27042	116	9	308.50	244.50	0	0	[illegible]	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	41	32	10
27042	117	9	0.00	0.00	0	0	10	3530.00	bif/point	frag	0	complt	24	none	0	0	17	30	26	6
51698	27	3	101.00	98.00	0	0	9	1011.04	graver	frag	10	complt	0	none	0	0	0	60	43	12
51698	48	3	93.00	94.00	0	0	10	1.02	bif-epre	frag	30	incomp	0	none	0	0	0	45	33	11
51698	83	4	127.00	135.00	0	0	6	1.03	gunflint	whole	0	complt	0	none	0	0	0	17	17	3
51698	91	4	119.40	135.00	0	0	7	3530.00	bif/point	frag	0	complt	26	none	0	0	11	27	21	5

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
51698	9	9	0.00	0.00	0	0	8	1.03	uniface	frag	0	incomp	0	none	0	0	0	53	30	8
51698	63	9	132.00	102.00	0	0	2	1.03	bif/point	whole	0	incomp	44	none	0	0	10	25	15	4
51698	64	9	0.00	0.00	0	0	3	3530.00	bif-blnk	frag	0	incomp	0	none	0	0	0	33	26	12
51700	110	1	296.00	291.00	0	0	7	3520.00	bif-epre	frag	0	incomp	0	none	0	0	0	28	13	6
51700	131	1	295.00	294.00	0	0	13	3530.00	ret-bi	frag	0	complt	0	none	0	0	0	23	18	6
51700	163	1	317.00	294.00	0	0	8	1.04	biface	frag	0	complt	0	none	0	0	0	13	11	2
51700	173	1	295.00	293.00	1	0	14	1.00	ret-uni	frag	0	incomp	0	none	0	0	0	37	25	5
51700	223	1	323.61	301.50	0	0	10	3520.00	bif/point	tip	0	complt	0	none	0	1	0	18	18	3
51700	5	2	344.00	301.00	0	0	11	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	28	24	10
51700	9	2	346.00	301.00	0	0	1	1.04	bif-blnk	frag	0	incomp	0	none	0	0	0	26	35	6
51700	12	2	342.66	303.23	0	0	2	3530.00	bif/point	basalfrg	0	indet	26	none	0	0	9	29	20	4
51700	21	2	345.99	303.24	0	0	3	1.01	bif/point	frag	0	indet	46	none	0	0	0	32	16	4
51700	25	2	347.00	303.00	0	0	12	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	18	10	3
51700	34	2	343.00	304.00	0	0	4	3530.00	biface	frag	0	complt	0	none	0	0	0	22	18	5
51700	53	2	343.00	306.00	0	0	5	3530.00	bif/drill	frag	0	complt	0	none	0	0	0	13	8	3
51700	60	2	347.79	307.63	0	0	6	3530.00	bif/point	frag	0	complt	50	none	0	0	0	14	12	3
51700	196	9	320.60	290.61	0	0	9	3530.00	bif/point	basalsnp	0	complt	30	none	0	0	15	13	17	5
51701	17	1	101.00	93.00	0	0	2	1.01	bif-epre	frag	20	incomp	0	none	0	0	0	53	50	18
51701	96	2	102.16	126.43	0	0	1	1.04	bif/point	whole	0	complt	54	none	0	0	5	19	12	3
51702	25	1	105.00	96.00	0	0	2	1.02	bif-epre	frag	0	incomp	0	none	0	0	0	19	13	8
51702	48	1	109.00	92.00	0	0	3	1.00	uniface	frag	0	incomp	0	none	0	0	0	30	19	10

Table F.1 (Continued).

:•	Arti- ·act .ot	Unit	North	East	Fea- ture	Level	Arti- fact No.	Mate- rial(1)	Tool(2) Type	Por- tion(3)	Cor- tex(4)	Complt (5)	Func- tional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
517C2	57	1	104.00	97.00	0	0	1	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	55	45	11
51702	8C	2	77.00	113.00	0	0	4	3530.00	ret-uni	whole	0	incomp	0	none	0	0	0	38	20	7
51703	26	1	127.00	99.00	0	0	15	1.03	ret-uni	frag	0	incomp	0	none	0	0	0	18	11	10
51703	38	1	132.00	98.00	0	0	1	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	38	12	6
51703	59	1	122.00	97.00	0	0	16	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	30	16	5
51703	70	1	126.00	97.00	0	0	2	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	28	27	8
51703	70	1	126.00	97.00	0	0	11	1.04	bif-epre	frag	10	incomp	0	none	0	0	0	36	17	11
51703	78	1	118.00	96.00	0	0	3	1.00	bif-blnk	frag	0	incomp	0	none	0	0	0	33	30	13
51703	80	1	118.00	97.00	0	0	4	3520.00	graver	whole	0	complt	0	none	0	0	0	25	19	4
51703	86	1	132.00	95.00	0	0	5	1.03	uniface	whole	0	incomp	0	none	0	0	0	27	18	2
51703	86	1	132.00	95.00	0	0	6	1.00	ret-uni	whole	0	incomp	0	none	0	0	0	38	23	13
51703	101	1	133.00	95.00	0	0	26	1.04	bif-blnk	frag	0	incomp	0	none	0	0	0	43	35	15
51703	199	2	104.00	81.00	0	0	27	3530.00	bif-epre	frag	0	incomp	0	none	0	0	0	14	9	3
51703	207	2	103.00	102.00	0	0	10	1.00	uniface	whole	0	incomp	0	none	0	0	0	30	25	10
51703	215	2	104.00	87.00	0	0	11	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	20	11	3
51703	257	1	104.33	90.43	0	0	12	3530.00	bif/point	basalfrg	0	complt	26	none	0	0	16	17	25	5
51703	269	2	104.00	94.00	0	0	21	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	17	10	7
51703	274	2	104.00	93.00	0	0	22	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	25	21	12
51703	286	2	104.00	84.00	0	0	23	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	23	18	6
51703	286	2	104.00	84.00	0	0	24	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	24	14	10
51703	296	2	103.00	80.00	0	0	25	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	24	17	3

Table F.1 (Continued).

Site	Artifact Lot	Unit	North	East	Feature	Level	Artifact No.	Material(1)	Tool(2) Type	Portion(3)	Cortex(4)	Complt (5)	Functional Angle	Use Type (6)	Use Angle (Degrees)	REW2	Haft Width (mm)	Length (mm)	Width (mm)	Thickness (mm)
51703	151	3	94.00	89.00	0	0	7	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	48	33	11
51703	163	3	91.00	90.00	0	0	19	1.03	uniface	frag	0	incomp	0	none	0	0	0	17	13	2
51703	179	3	99.00	86.00	0	0	8	1.03	bif-epre	frag	0	incomp	0	none	0	0	0	23	21	9
51703	187	3	93.00	85.00	0	0	9	1.04	bif-epre	frag	0	incomp	0	none	0	0	0	32	21	7
51703	297	9	95.00	82.00	0	0	13	1.04	bif-lpre	frag	0	complt	0	none	0	0	0	25	19	5
51703	298	9	111.00	89.00	0	0	14	3530.00	biface	frag	0	complt	0	none	0	0	0	20	18	2

Footnotes for Table F.1

(1) Material: Four-digit Warren code with heat treatment code
Heat treatment:
.00-None
.01-Successful
.02-Unsuccessful
.03-Successful from flake
04-Successful from core
.05-Unknown

(2) Tool type: biface, uniface, biface/projectile point, extensive marginal retouch unidirectional, extensive marginal retouch bidirectional, biface drill, perforator, graver, end scraper, thumbnail scraper, gunflint

Biface stage: blanks, early preform, late preform, bifacial tools

(3) Portion: whole, fragment, basal, tip, midsection, lateral, basal snap

(4) To the nearest 10%

(5) Complete/incomplete: complete, incomplete, undetermined

(6) Use type: none, unidirectional (hard), unidirectional (soft), bidirectional, battering, boring/drilling

APPENDIX G

K-MEANS CLUSTER ANALYSES

Table G.1 K-Means Cluster Analysis for Site LA 25328, Abiquiu Archaeological Study, ACOE, 1989.

THE FOLLOWING RESULTS ARE FOR:
SITE = 25328.000

SUMMARY STATISTICS FOR 34 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	5.531	33	0.026	39	253.441	0.000
EAST	7.228	33	0.057	39	150.700	0.000
POLEQUI	62.141	33	0.191	40	394.096	0.000

CLUSTER NUMBER: 1

MEMBERS			STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.06	NRTH	-0.84	-0.75	-0.72	0.03
deb	0.02	EAST	-0.80	-0.72	-0.69	0.03
deb	0.04	POLEQUI	-0.51	-0.41	-0.31	0.08
deb	0.06					
deb	0.05					
deb	0.02					
deb	0.04					
deb	0.07					
deb	0.07					

CLUSTER NUMBER: 2

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-1.06	-1.06	-1.06	0.00
		EAST	-0.50	-0.50	-0.50	0.00
		POLEQUI	-1.86	-1.86	-1.86	0.00

CLUSTER NUMBER: 3

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.93	-0.93	-0.93	0.00
		EAST	-0.93	-0.93	-0.93	0.00
		POLEQUI	4.20	4.20	4.20	0.00

Table G.1 (Continued).

CLUSTER NUMBER: 4

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.02	NRTH	-1.07	-1.05	-1.02	0.02
point	0.03	EAST	-0.32	-0.27	-0.24	0.03
tool	0.07	POLEQUI	0.24	0.31	0.42	0.07
tool	0.04					

CLUSTER NUMBER: 5

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.93	-0.93	-0.93	0.00
point	0.00	EAST	-0.93	-0.93	-0.93	0.00
		POLEQUI	1.25	1.26	1.26	0.01

CLUSTER NUMBER: 6

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.02	NRTH	-0.28	-0.25	-0.24	0.01
deb	0.01	EAST	-1.28	-1.26	-1.23	0.02
deb	0.02	POLEQUI	-0.20	-0.18	-0.16	0.01
tool	0.02					

CLUSTER NUMBER: 7

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-0.23	-0.23	-0.23	0.00
		EAST	-1.30	-1.30	-1.30	0.00
		POLEQUI	1.28	1.28	1.28	0.00

CLUSTER NUMBER: 8

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.02	NRTH	-1.05	-1.03	-1.01	0.02
tool	0.03	EAST	-0.25	-0.24	-0.24	0.01
tool	0.01	POLEQUI	-0.41	-0.37	-0.32	0.04
tool	0.02					

Table G.1 (Continued).

CLUSTER NUMBER: 9

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.07	NRTH	-0.72	-0.67	-0.62	0.05
tool	0.07	EAST	-0.89	-0.78	-0.68	0.10
		POLEQUI	-0.94	-0.91	-0.89	0.03

CLUSTER NUMBER: 10

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
?	0.00	NRTH	0.00	0.00	0.00	0.00
		EAST	0.00	0.00	0.00	0.00
		POLEQUI	-2.53	-2.53	-2.53	0.00

CLUSTER NUMBER: 11

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.04	NRTH	-1.15	-1.14	-1.13	0.01
deb	0.02	EAST	-0.99	-0.99	-0.98	0.01
deb	0.02	POLEQUI	0.05	0.09	0.16	0.05

CLUSTER NUMBER: 12

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-1.07	-1.07	-1.07	0.00
		EAST	-0.50	-0.50	-0.50	0.00
		POLEQUI	1.98	1.98	1.98	0.00

CLUSTER NUMBER: 13

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.02	NRTH	-1.07	-1.07	-1.07	0.00
tool	0.02	EAST	-0.54	-0.52	-0.50	0.02
		POLEQUI	0.74	0.75	0.77	0.01

Table G.1 (Continued).

CLUSTER NUMBER: 14

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.04	NRTH	-1.16	-1.14	-1.12	0.01
deb	0.02	EAST	-0.98	-0.95	-0.90	0.04
deb	0.02	POLEQUI	-0.59	-0.56	-0.53	0.02

CLUSTER NUMBER: 15

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.06	NRTH	-1.07	-1.05	-1.02	0.02
tool	0.06	EAST	-0.34	-0.29	-0.24	0.05
		POLEQUI	-0.91	-0.82	-0.73	0.09

CLUSTER NUMBER: 16

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.02	NRTH	-0.83	-0.83	-0.83	0.00
point	0.02	EAST	-0.82	-0.82	-0.82	0.00
		POLEQUI	0.59	0.62	0.66	0.04

CLUSTER NUMBER: 17

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.46	-0.46	-0.46	0.00
		EAST	-0.81	-0.81	-0.81	0.00
		POLEQUI	1.72	1.72	1.72	0.00

CLUSTER NUMBER: 18

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.07	NRTH	-0.84	-0.78	-0.74	0.03
deb	0.03	EAST	-0.78	-0.73	-0.69	0.03
deb	0.05	POLEQUI	-0.14	-0.05	0.05	0.06
deb	0.03					
deb	0.03					

Table G.1 (Continued).

CLUSTER NUMBER: 19

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-1.07	-1.07	-1.07	0.00
		EAST	-0.50	-0.50	-0.50	0.00
		POLEQUI	1.52	1.52	1.52	0.00

CLUSTER NUMBER: 20

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-1.07	-1.07	-1.07	0.00
		EAST	-0.54	-0.54	-0.54	0.00
		POLEQUI	-0.10	-0.10	-0.10	0.00

CLUSTER NUMBER: 21

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-0.23	-0.23	-0.23	0.00
		EAST	-1.30	-1.30	-1.30	0.00
		POLEQUI	0.01	0.01	0.01	0.00

CLUSTER NUMBER: 22

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.03	NRTH	-0.70	-0.70	-0.70	0.00
point	0.03	EAST	-0.67	-0.67	-0.67	0.00
		POLEQUI	1.46	1.51	1.56	0.05

CLUSTER NUMBER: 23

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.04	NRTH	-1.07	-1.07	-1.07	0.00
tool	0.04	EAST	-0.50	-0.50	-0.50	0.00
		POLEQUI	0.98	1.05	1.12	0.07

Table G.1 (Continued).

CLUSTER NUMBER: 24

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.93	-0.93	-0.93	0.00
		EAST	-0.93	-0.93	-0.93	0.00
		POLEQUI	1.61	1.61	1.61	0.00

CLUSTER NUMBER: 25

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.07	NRTH	-0.63	-0.63	-0.63	0.00
tool	0.06	EAST	-0.54	-0.54	-0.54	0.00
tool	0.02	POLEQUI	-0.22	-0.12	0.01	0.10

CLUSTER NUMBER: 26

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.02	NRTH	-0.26	-0.25	-0.23	0.01
deb	0.04	EAST	-1.25	-1.22	-1.20	0.02
deb	0.03	POLEQUI	-0.52	-0.45	-0.40	0.05

CLUSTER NUMBER: 27

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.03	NRTH	-1.05	-1.04	-1.04	0.00
deb	0.03	EAST	-0.27	-0.25	-0.23	0.02
		POLEQUI	0.51	0.56	0.62	0.05

CLUSTER NUMBER: 28

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
?	0.00	NRTH	-1.07	-1.07	-1.07	0.00
		EAST	-0.50	-0.50	-0.50	0.00
		POLEQUI	0.47	0.47	0.47	0.00

Table G.1 (Continued).

CLUSTER NUMBER: 29

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.62	-0.62	-0.62	0.00
		EAST	-0.89	-0.89	-0.89	0.00
		POLEQUI	-0.49	-0.49	-0.49	0.00

CLUSTER NUMBER: 30

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-1.14	-1.14	-1.14	0.00
		EAST	-0.85	-0.85	-0.85	0.00
		POLEQUI	0.64	0.64	0.64	0.00

CLUSTER NUMBER: 31

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.04	NRTH	-1.05	-1.03	-1.01	0.02
tool	0.04	EAST	-0.32	-0.31	-0.30	0.01
		POLEQUI	-0.63	-0.57	-0.52	0.06

CLUSTER NUMBER: 32

MEMBERS		STATISTICS				
CASE	DISTANCE	VARI[illegible]E	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-1.07	-1.07	-1.07	0.00
		EAST	-0.25	-0.25	-0.25	0.00
		POLEQUI	0.79	0.79	0.79	0.00

CLUSTER NUMBER: 33

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.01	NRTH	-1.05	-1.05	-1.05	0.00
tool	0.02	EAST	-0.32	-0.3[illegible]	-0.27	0.03
tool	0.03	POLEQUI	-0.20	-0.17	-0.15	0.02

Table G.1 (Continued).

CLUSTER NUMBER: 34

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	|	NRTH	-0.73	-0.73	-0.73	0.00
		|	EAST	-0.77	-0.77	-0.77	0.00
		|	POLEQUI	0.10	0.10	0.10	0.00

Table G.2 K-Means Cluster Analysis for Site LA 25330, Abiquiu Archaeological Study, ACOE, 1989.

THE FOLLOWING RESULTS ARE FOR:
SITE = 25330.000

SUMMARY STATISTICS FOR 7 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	0.045	6	0.014	8	4.425	0.029
EAST	0.187	6	0.018	8	13.683	0.001
POLEQUI	15.516	6	0.048	8	434.150	0.000

CLUSTER NUMBER: 1

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.02	|	NRTH	-0.65	-0.64	-0.62	0.01
tool	0.03	|	EAST	-0.81	-0.77	-0.73	0.04
tool	0.05	|	POLEQUI	-0.95	-0.86	-0.80	0.05
tool	0.04	|					

CLUSTER NUMBER: 2

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	|	NRTH	-0.63	-0.63	-0.63	0.00
		|	EAST	-0.77	-0.77	-0.77	0.00
		|	POLEQUI	3.28	3.28	3.28	0.00

CLUSTER NUMBER: 3

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.07	|	NRTH	-0.61	-0.55	-0.49	0.06
deb	0.04	|	EAST	-0.65	-0.55	-0.51	0.06
deb	0.04	|	POLEQUI	0.37	0.49	0.54	0.07
deb	0.08	|					

Table G.2 (Continued).

CLUSTER NUMBER: 4

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	I	NRTH	-0.59	-0.59	-0.59	0.00
		I	EAST	-0.82	-0.82	-0.82	0.00
		I	POLEQUI	0.90	0.90	0.90	0.00

CLUSTER NUMBER: 5

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.05	I	NRTH	-0.53	-0.52	-0.51	0.01
deb	0.05	I	EAST	-0.51	-0.50	-0.50	0.01
		I	POLEQUI	-0.00	0.09	0.18	0.09

CLUSTER NUMBER: 6

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	I	NRTH	-0.67	-0.67	-0.67	0.00
tool	0.00	I	EAST	-0.62	-0.62	-0.62	0.00
		I	POLEQUI	-0.40	-0.39	-0.39	0.00

CLUSTER NUMBER: 7

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	I	NRTH	-0.67	-0.67	-0.67	0.00
		I	EAST	-0.62	-0.62	-0.62	0.00
		I	POLEQUI	-0.05	-0.05	-0.05	0.00

Table G.3 K-Means Cluster Analysis for Site LA 51698, Abiquiu Archaeological Study, ACOE, 1989.

THE FOLLOWING RESULTS ARE FOR:
SITE = 51698.000

SUMMARY STATISTICS FOR 7 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	0.048	6	0.007	3	3.648	0.158
EAST	0.319	6	0.027	3	5.832	0.088
POLEQUI	31.794	6	0.031	3	505.929	0.000

CLUSTER NUMBER: 1

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.04	I	NRTH	-0.75	-0.70	-0.64	0.05
point	0.04	I	EAST	-0.92	-0.90	-0.89	0.02
		I	POLEQUI	-0.30	-0.26	-0.21	0.05

CLUSTER NUMBER: 2

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	I	NRTH	-0.67	-0.67	-0.67	0.00
		I	EAST	-0.81	-0.81	-0.81	0.00
		I	POLEQUI	4.72	4.72	4.72	0.00

CLUSTER NUMBER: 3

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.07	I	NRTH	-0.67	-0.66	-0.64	0.02
deb	0.07	I	EAST	-0.92	-0.86	-0.81	0.05
		I	POLEQUI	1.79	1.90	2.02	0.12

CLUSTER NUMBER: 4

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.06	I	NRTH	-0.53	-0.53	-0.52	0.01
point	0.06	I	EAST	-0.64	-0.54	-0.43	0.10
		I	POLEQUI	-0.99	-0.99	-0.98	0.01

CLUSTER NUMBER: 5

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	I	NRTH	-0.66	-0.66	-0.66	0.00
		I	EAST	-0.91	-0.91	-0.91	0.00
		I	POLEQUI	1.18	1.18	1.18	0.00

Table G.3 (Continued).

CLUSTER NUMBER: 6

MEMBERS				STATISTICS			
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
deb	0.00	I	NRTH	-0.64	-0.64	-0.64	0.00
		I	EAST	-0.92	-0.92	-0.92	0.00
		I	POLEQUI	-0.58	-0.58	-0.58	0.00

CLUSTER NUMBER: 7

MEMBERS				STATISTICS			
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
point	0.00	I	NRTH	-0.52	-0.52	-0.52	0.00
		I	EAST	-0.43	-0.43	-0.43	0.00
		I	POLEQUI	-1.19	-1.19	-1.19	0.00

Table G.4 K-Means Cluster Analysis for Site LA 25480, Abiquiu Archaeological Study, ACOE, 1989.

THE FOLLOWING RESULTS ARE FOR:
SITE = 25480.000

SUMMARY STATISTICS FOR 21 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	0.587	20	0.160	26	4.779	0.000
EAST	1.303	20	0.040	26	42.380	0.000
POLEQUI	88.091	20	0.114	25	967.869	0.000

CLUSTER NUMBER: 1

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.02	NRTH	1.74	1.77	1.79	0.02
deb	0.05	EAST	1.55	1.62	1.68	0.05
tool	0.05	POLEQUI	-0.25	-0.19	-0.13	0.05

CLUSTER NUMBER: 2

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.03	NRTH	1.97	1.97	1.97	0.00
point	0.03	EAST	1.67	1.72	1.77	0.05
		POLEQUI	7.58	7.58	7.58	0.00

CLUSTER NUMBER: 3

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.04	NRTH	1.67	1.73	1.77	0.05
deb	0.03	EAST	1.35	1.36	1.38	0.02
deb	0.04	POLEQUI	2.18	2.22	2.29	0.05

CLUSTER NUMBER: 4

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.06	NRTH	1.74	1.84	1.97	0.10
tool	0.07	EAST	1.67	1.70	1.72	0.02
tool	0.08	POLEQUI	-0.62	-0.54	-0.43	0.07
deb	0.08					
deb	0.04					
deb	0.04					
tool	0.07					
deb	0.09					

CLUSTER NUMBER: 5

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	[illegible]	1.77	1.77	0.00
		EAST	[illegible]	1.70	1.70	0.00
		POLEQUI	[illegible]	-1.42	-1.42	0.00

Table G.4 (Continued).

CLUSTER NUMBER: 6

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	|	NRTH	1.58	1.58	1.58	0.00
		|	EAST	1.39	1.39	1.39	0.00
		|	POLEQUI	1.16	1.16	1.16	0.00

CLUSTER NUMBER: 7

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.07	|	NRTH	1.77	1.88	1.95	0.08
deb	0.03	|	EAST	1.67	1.68	1.68	0.01
deb	0.05	|	POLEQUI	0.35	0.38	0.44	0.04

CLUSTER NUMBER: 8

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	|	NRTH	1.52	1.52	1.52	0.00
point	0.00	|	EAST	1.34	1.34	1.34	0.00
		|	POLEQUI	-0.44	-0.44	-0.43	0.00

CLUSTER NUMBER: 9

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.03	|	NRTH	1.73	1.75	1.76	0.01
tool	0.03	|	EAST	1.36	1.37	1.38	0.01
		|	POLEQUI	0.16	0.22	0.27	0.06

CLUSTER NUMBER: 10

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.08	|	NRTH	1.75	1.80	1.97	0.09
tool	0.09	|	EAST	1.56	1.60	1.74	0.06
tool	0.03	|	POLEQUI	-0.83	-0.77	-0.70	0.06
tool	0.08	|					
deb	0.07	|					

CLUSTER NUMBER: 11

MEMBERS			STATISTICS				
CASE	DISTANCE	|	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.02	|	NRTH	1.77	1.77	1.77	0.00
deb	0.02	|	EAST	1.36	1.37	1.38	0.01
		|	POLEQUI	0.67	0.71	0.75	0.04

Table G.4 (Continued).

CLUSTER NUMBER: 12

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.05	NRTH	1.77	1.77	1.77	0.00
tool	0.05	EAST	1.37	1.37	1.37	0.00
		POLEQUI	-0.82	-0.74	-0.65	0.08

CLUSTER NUMBER: 13

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.05	NRTH	1.55	1.63	1.70	0.07
point	0.05	EAST	1.40	1.43	1.47	0.03
		POLEQUI	-0.08	-0.06	-0.05	0.01

CLUSTER NUMBER: 14

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	1.77	1.77	1.77	0.00
		EAST	1.35	1.35	1.35	0.00
		POLEQUI	1.57	1.57	1.57	0.00

CLUSTER NUMBER: 15

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	1.94	1.94	1.94	0.00
		EAST	1.68	1.68	1.68	0.00
		POLEQUI	0.68	0.68	0.68	0.00

CLUSTER NUMBER: 16

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	1.56	1.56	1.56	0.00
		EAST	1.14	1.14	1.14	0.00
		POLEQUI	0.10	0.10	0.10	0.00

CLUSTER NUMBER: 17

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.05	NRTH	1.77	1.78	1.78	0.01
deb	0.05	EAST	1.35	1.36	1.37	0.01
		POLEQUI	-0.40	0.32	[illegible]	0.08

CLUSTER NUMBER: 18

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.01	NRTH	1.74	1.75	1.77	0.01
deb	0.01	EAST	1.70	1.71	1.72	0.01
		POLEQUI	0.08	0.08	0.08	0.00

Table G.4 (Continued).

CLUSTER NUMBER: 19

MEMBERS			STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.03	NRTH	1.92	1.95	1.97	0.02
deo	0.03	EAST	1.67	1.69	1.71	0.02
		POLEQUI	-0.43	-0.39	-0.35	0.04

CLUSTER NUMBER: 20

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	1.89	1.89	1.89	0.00
		EAST	1.72	1.72	1.72	0.00
		POLEQUI	-1.12	-1.12	1.12	0.00

CLUSTER NUMBER: 21

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	1.97	1.97	1.97	0.00
		EAST	1.67	1.67	1.67	0.00
		POLEQUI	-0.17	-0.17	-0.17	0.00

Table G.5 K-Means Cluster Analysis for Site LA 27018, Abiquiu Archaeological Study, ACOE, 1989.

THE FOLLOWING RESULTS ARE FOR:
SITE = 27018.000

SUMMARY STATISTICS FOR 19 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	0.334	18	0.004	16	72.743	0.000
EAST	6.114	18	0.012	16	470.557	0.000
POLEQUI	14.681	18	0.043	14	263.478	0.000

CLUSTER NUMBER: 1

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.04	NRTH	-0.67	-0.64	-0.62	0.02
deb	0.04	EAST	-0.81	-0.77	-0.75	0.02
deb	0.01	POLEQUI	-0.42	-0.34	-0.27	0.06
deb	0.05					
deb	0.02					
deb	0.04					

CLUSTER NUMBER: 2

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.67	-0.67	-0.67	0.00
		EAST	-0.26	-0.26	-0.26	0.00
		POLEQUI	0.91	0.91	0.91	0.00

CLUSTER NUMBER: 3

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.03	NRTH	-0.30	-0.30	-0.30	0.00
tool	0.03	EAST	-1.81	-1.81	-1.81	0.00
		POLEQUI	0.22	0.27	0.32	0.05

CLUSTER NUMBER: 4

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.04	NRTH	-0.68	-0.66	-0.64	0.02
deb	0.04	EAST	-0.55	-0.53	-0.51	0.02
		POLEQUI	1.63	1.70	1.78	0.07

Table G.5 (Continued).

CLUSTER NUMBER: 5

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.01	NRTH	-0.58	-0.58	-0.58	0.00
point	0.01	EAST	-0.06	-0.06	-0.06	0.00
point	0.02	POLEQUI	-0.49	-0.47	-0.43	0.03

CLUSTER NUMBER: 6

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.03	NRTH	-0.66	-0.65	-0.64	0.01
tool	0.00	EAST	-0.76	-0.74	-0.70	0.02
tool	0.03	POLEQUI	-0.58	-0.53	-0.50	0.03
deb	0.02					

CLUSTER NUMBER: 7

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.67	-0.67	-0.67	0.00
		EAST	-0.26	-0.26	-0.26	0.00
		POLEQUI	0.52	0.52	0.52	0.00

CLUSTER NUMBER: 8

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-0.66	-0.66	-0.66	0.00
		EAST	-0.77	-0.77	-0.77	0.00
		POLEQUI	0.45	0.45	0.45	0.00

CLUSTER NUMBER: 9

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.30	-0.30	-0.30	0.00
		EAST	-1.81	-1.81	-1.81	0.00
		POLEQUI	-0.16	-0.16	-0.16	0.00

Table G.5 (Continued).

CLUSTER NUMBER: 10

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.62	-0.62	-0.62	0.00
		EAST	-0.63	-0.63	-0.63	0.00
		POLEQUI	-0.85	-0.85	-0.85	0.00

CLUSTER NUMBER: 11

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.68	-0.68	-0.68	0.00
		EAST	-0.55	-0.55	-0.55	0.00
		POLEQUI	1.34	1.34	1.34	0.00

CLUSTER NUMBER: 12

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.04	NRTH	-0.67	-0.65	-0.63	0.02
deb	0.03	EAST	-0.57	-0.52	-0.47	0.04
point	0.02	POLEQUI	-0.25	-0.22	-0.18	0.03

CLUSTER NUMBER: 13

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.01	NRTH	-0.66	-0.65	-0.64	0.01
deb	0.01	EAST	-0.81	-0.80	-0.80	0.01
		POLEQUI	-0.71	-0.71	-0.71	0.00

CLUSTER NUMBER: 14

MEMBERS CASE	DISTANCE	STATISTICS VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.62	-0.62	-0.62	0.00
		EAST	-0.55	-0.55	-0.55	0.00
		POLEQUI	0.95	0.95	0.95	0.00

Table G.5 (Continued).

CLUSTER NUMBER: 15

MEMBERS CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.02	NRTH	-0.63	-0.63	-0.63	0.00
deb	0.02	EAST	-0.53	-0.52	-0.51	0.01
		POLEQUI	-0.43	-0.41	-0.38	0.03

CLUSTER NUMBER: 16

MEMBERS CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-0.64	-0.64	-0.64	0.00
		EAST	-0.51	-0.51	-0.51	0.00
		POLEQUI	0.35	0.35	0.35	0.00

CLUSTER NUMBER: 17

MEMBERS CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.58	-0.58	-0.58	0.00
		EAST	-0.06	-0.06	-0.06	0.00
		POLEQUI	0.36	0.36	0.36	0.00

CLUSTER NUMBER: 18

MEMBERS CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-0.65	-0.65	-0.65	0.00
		EAST	-0.75	-0.75	-0.75	0.00
		POLEQUI	-0.16	-0.16	-0.16	0.00

CLUSTER NUMBER: 19

MEMBERS CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.62	-0.62	-0.62	0.00
		EAST	-0.63	-0.63	-0.63	0.00
		POLEQUI	-0.60	-0.60	-0.60	0.00

Table G.6 K-Means Cluster Analysis for Site LA 27020, Abiquiu Archaeological Study, ACOE, 1989.

THE FOLLOWING RESULTS ARE FOR:
SITE = 27020.000

SUMMARY STATISTICS FOR 5 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	0.179	4	0.001	3	156.090	0.001
EAST	0.433	4	0.015	3	21.779	0.015
POLEQUI	1.398	4	0.014	2	51.504	0.019

CLUSTER NUMBER: 1

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.05	NRTH	-0.61	-0.59	-0.57	0.02
tool	0.05	EAST	-0.62	-0.53	-0.44	0.09
		POLEQUI	-0.01	0.00	0.02	0.01

CLUSTER NUMBER: 2

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.82	-0.82	-0.82	0.00
point	0.00	EAST	-0.44	-0.44	-0.44	0.00
		POLEQUI	0.64	0.64	0.64	0.00

CLUSTER NUMBER: 3

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.37	-0.37	-0.37	0.00
		EAST	-0.03	-0.03	-0.03	0.00
		POLEQUI	-0.84	-0.84	-0.84	0.00

CLUSTER NUMBER: 4

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.82	-0.82	-0.82	0.00
		EAST	-0.26	-0.26	-0.26	0.00
		POLEQUI	-0.37	-0.37	-0.37	0.00

CLUSTER NUMBER: 5

CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.05	NRTH	-0.62	-0.62	-0.62	0.00
point	0.05	EAST	-0.78	-0.78	-0.78	0.00
		POLEQUI	-0.58	-0.50	-0.42	0.08

Table G.6 (Continued).

ADDITIONAL ANALYSES FOR SITE LA 27020

# CLUSTERS	# IN LEST CLUSTER	#SINGLETONS	OVERALL LARGEST DATE S.D.	F-RATIO
5	2	2	0.08	51.50

POL	N	E	#	CL#
+0.64	-0.82	-0.44	2/1 ITEM	2
0.00	-0.59	-0.53	2	1
-0.37	-0.82	-0.26	1	4
-0.50	-0.62	-0.78	2(R)	5
-0.84	-0.37	-0.03	1	3

NOTES:

NO SPATIAL CLUSTERS, SINCE SAMPLE TOO SMALL.

NO CLEAR TEMPORAL CLUSTERS, UNLESS AT POL = 0.00 ON 1 TOOL AND 1 DEBITAGE ITEM.

SPACE/TIME SAMPLE SIZE TOO SMALL FOR CONCLUSIONS.

Table G.7 K-Means Cluster Analysis for Site LA 27041, Abiquiu Archaeological Study, ACOE, 1989.

THE FOLLOWING RESULTS ARE FOR:
SITE = 27041.000

SUMMARY STATISTICS FOR 12 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	0.007	11	0.004	15	2.170	0.082
EAST	0.021	11	0.013	15	2.198	0.078
POLEQUI	5.133	11	0.015	15	472.833	0.000

CLUSTER NUMBER: 1

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.02	NRTH	-0.47	-0.45	-0.43	0.01
deb	0.03	EAST	-0.73	-0.70	-0.66	0.03
tool	0.02	POLEQUI	-0.47	-0.45	-0.42	0.02
point	0.02					
point	0.03					

CLUSTER NUMBER: 2

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.02	NRTH	-0.48	-0.47	-0.47	0.00
deb	0.02	EAST	-0.72	-0.71	-0.68	0.02
tool	0.01	POLEQUI	0.24	0.27	0.29	0.02

CLUSTER NUMBER: 3

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.01	NRTH	-0.48	-0.48	-0.48	0.00
deb	0.01	EAST	-0.66	-0.66	-0.66	0.00
		POLEQUI	-1.08	-1.07	-1.05	0.01

Table G.7 (Continued).

CLUSTER NUMBER: 4

MEMBERS CASE	DISTANCE	VARIABLE	STATISTICS MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-0.47	-0.47	-0.47	0.00
		EAST	-0.68	-0.68	-0.68	0.00
		POLEQUI	0.68	0.68	0.68	0.00

CLUSTER NUMBER: 5

MEMBERS CASE	DISTANCE	VARIABLE	STATISTICS MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.01	NRTH	-0.47	-0.47	-0.47	0.00
deb	0.02	EAST	-0.72	-0.71	-0.69	0.01
tool	0.03	POLEQUI	-0.28	-0.23	-0.20	0.03

CLUSTER NUMBER: 6

MEMBERS CASE	DISTANCE	VARIABLE	STATISTICS MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.03	NRTH	-0.47	-0.47	-0.47	0.00
deb	0.03	EAST	-0.72	-0.69	-0.66	0.03
		POLEQUI	0.04	0.09	0.13	0.04

CLUSTER NUMBER: 7

MEMBERS CASE	DISTANCE	VARIABLE	STATISTICS MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.03	NRTH	-0.53	-0.50	-0.47	0.03
tool	0.03	EAST	-0.69	-0.66	-0.63	0.03
		POLEQUI	-0.10	-0.08	-0.06	0.02

CLUSTER NUMBER: 8

MEMBERS CASE	DISTANCE	VARIABLE	STATISTICS MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.03	NRTH	-0.48	-0.45	-0.43	0.02
deb	0.03	EAST	-0.70	-0.68	-0.66	0.02
		POLEQUI	-0.89	-0.86	-0.83	0.03

Table G.7 (Continued).

CLUSTER NUMBER: 9

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.43	-0.43	-0.43	0.00
		EAST	-0.80	-0.80	-0.80	0.00
		POLEQUI	-0.13	-0.13	-0.13	0.00

CLUSTER NUMBER: 10

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.02	NRTH	-0.47	-0.45	-0.43	0.01
deb	0.02	EAST	-0.72	-0.71	-0.68	0.02
tool	0.02	POLEQUI	-0.63	-0.62	-0.60	0.02
deb	0.01					

CLUSTER NUMBER: 11

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-0.48	-0.48	-0.48	0.00
		EAST	-0.66	-0.66	-0.66	0.00
		POLEQUI	0.37	0.37	0.37	0.00

CLUSTER NUMBER: 12

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	-0.48	-0.48	-0.48	0.00
		EAST	-0.66	-0.66	-0.66	0.00
		POLEQUI	-0.32	-0.32	-0.32	0.00

Table G.8 **K-Means Cluster Analysis for Site LA 27042, Abiquiu Archaeological Study, ACOE, 1989.**

SUMMARY STATISTICS FOR 17 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	3.035	16	0.004	17	799.176	0.000
EAST	0.893	16	0.011	17	84.618	0.000
POLEQUI	13.537	16	0.024	17	590.454	0.000

CLUSTER NUMBER: 1

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.01	NRTH	0.96	0.98	1.03	0.03
tool	0.02	EAST	1.34	1.35	1.36	0.01
tool	0.03	POLEQUI	0.25	0.28	0.29	0.02

CLUSTER NUMBER: 2

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	0.52	0.52	0.52	0.00
		EAST	1.06	1.06	1.06	0.00
		POLEQUI	2.65	2.65	2.65	0.00

CLUSTER NUMBER: 3

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	0.89	0.89	0.89	0.00
		EAST	1.19	1.19	1.19	0.00
		POLEQUI	1.33	1.33	1.33	0.00

Table [illegible] (continued).

CLUSTER NUMBER: [illegible]

MEMBERS			STATISTICS			
CASE	DISTANCE	[illegible]	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	[illegible]	[illegible]	[illegible].49	0.49	0.51	0.01
deb	[illegible]	[illegible]	[illegible].03	1.04	1.05	0.00
deb	[illegible]	[illegible]	-0.33	-0.30	-0.26	0.02
deb	[illegible]					
deb	[illegible]					
deb	[illegible]					

CLUSTER NUMBER: [illegible]

MEMBERS			STATISTICS			
CASE	[illegible]	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
[illegible]	[illegible]	NRTH	0.49	0.50	0.51	0.01
[illegible]	[illegible]	EAST	1.03	1.05	1.06	0.01
		POLEQUI	-1.01	-1.00	-1.00	0.01

CLUSTER NUMBER: [illegible]

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
[illegible]	0.03	NRTH	0.50	0.50	0.50	0.00
[illegible]	0.03	EAST	1.05	1.05	1.06	0.01
		POLEQUI	0.13	0.18	0.23	0.05

CLUSTER NUMBER: 7

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	1.03	1.03	1.03	0.00
		EAST	1.76	1.76	1.76	0.00
		POLEQUI	0.13	0.13	0.13	0.00

CLUSTER NUMBER: 8

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.01	NRTH	1.51	1.51	1.51	0.00
point	0.01	EAST	1.35	1.35	1.35	0.00
		POLEQUI	0.22	0.23	0.24	0.01

Table G.8 (Continued).

CLUSTER NUMBER: 9

MEMBERS			STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.01	NRTH	0.74	0.75	0.75	0.01
deb	0.01	EAST	1.35	1.35	1.36	0.01
deb	0.01	POLEQUI	-0.30	-0.28	-0.27	0.02

CLUSTER NUMBER: 10

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.05	NRTH	1.05	1.06	1.06	0.00
deb	0.05	EAST	1.20	1.27	1.34	0.07
		POLEQUI	0.45	0.48	0.52	0.03

CLUSTER NUMBER: 11

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.03	NRTH	0.49	0.49	0.49	0.00
deb	0.03	EAST	1.03	1.03	1.03	0.00
		POLEQUI	-0.60	-0.55	-0.50	0.05

CLUSTER NUMBER: 12

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.01	NRTH	1.06	1.06	1.06	0.00
deb	0.01	EAST	1.24	1.26	1.27	0.02
		POLEQUI	0.00	0.01	0.01	0.00

CLUSTER NUMBER: 13

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	0.89	0.89	0.89	0.00
		EAST	1.19	1.19	1.19	0.00
		POLEQUI	-0.47	-0.47	-0.47	0.00

Table G.8 (Continued).

CLUSTER NUMBER: 14

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	1.05	1.05	1.05	0.00
		EAST	1.34	1.34	1.34	0.00
		POLEQUI	-0.22	-0.22	-0.22	0.00

CLUSTER NUMBER: 15

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	0.52	0.52	0.52	0.00
		EAST	1.06	1.06	1.06	0.00
		POLEQUI	0.40	0.40	0.40	0.00

CLUSTER NUMBER: 16

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.03	NRTH	1.06	1.06	1.07	0.00
tool	0.01	EAST	1.20	1.20	1.21	0.01
deb	0.04	POLEQUI	0.14	0.19	0.25	0.05

CLUSTER NUMBER: 17

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	0.99	0.99	0.99	0.00
		EAST	1.34	1.34	1.34	0.00
		POLEQUI	-0.05	-0.05	-0.05	0.00

Table G.9 K-Means Cluster Analysis for Site LA 27002, Abiquiu Archaeological Study, ACOE, 1989.

THE FOLLOWING RESULTS ARE FOR:
SITE = 27002.000

SUMMARY STATISTICS FOR 7 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	0.013	6	0.001	2	3.370	0.246
EAST	0.020	6	0.002	2	4.000	0.213
POLEQUI	4.060	6	0.001	2	994.887	0.001

CLUSTER NUMBER: 1

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.03	NRTH	-0.48	-0.46	-0.43	0.02
deb	0.01	EAST	-0.69	-0.67	-0.64	0.02
tool	0.02	POLEQUI	-0.30	-0.27	-0.25	0.02

CLUSTER NUMBER: 2

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.57	-0.57	-0.57	0.00
		EAST	-0.79	-0.79	-0.79	0.00
		POLEQUI	1.88	1.88	1.88	0.00

CLUSTER NUMBER: 3

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.44	-0.44	-0.44	0.00
		EAST	-0.68	-0.68	-0.68	0.00
		POLEQUI	0.05	0.05	0.05	0.00

CLUSTER NUMBER: 4

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.44	-0.44	-0.44	0.00
		EAST	-0.68	-0.68	-0.68	0.00
		POLEQUI	-0.16	-0.16	-0.16	0.00

Table G.9 (Continued).

CLUSTER NUMBER: 5

MEMBERS CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.43	-0.43	-0.43	0.00
		EAST	-0.64	-0.64	-0.64	0.00
		POLEQUI	0.24	0.24	0.24	0.00

CLUSTER NUMBER: 6

MEMBERS CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.47	-0.47	-0.47	0.00
		EAST	-0.69	-0.69	-0.69	0.00
		POLEQUI	-0.37	-0.37	-0.37	0.00

CLUSTER NUMBER: 7

MEMBERS CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.48	-0.48	-0.48	0.00
		EAST	-0.61	-0.61	-0.61	0.00
		POLEQUI	-0.34	-0.34	-0.34	0.00

Table G.10 **K-Means Cluster Analysis for Site LA 25532, Abiquiu Archaeological Study, ACOE, 1989.**

THE FOLLOWING RESULTS ARE FOR:
SITE = 25532.000

SUMMARY STATISTICS FOR 15 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	0.088	14	0.010	11	6.660	0.002
EAST	0.367	14	0.005	11	54.485	0.000
POLEQUI	7.689	14	0.014	11	419.925	0.000

CLUSTER NUMBER: 1

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
tool	0.01	NRTH	-0.56	-0.55	-0.53	0.02
deb	0.01	EAST	-0.54	-0.53	-0.50	0.02
tool	0.02	POLEQUI	-0.65	-0.64	-0.63	0.01

CLUSTER NUMBER: 2

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
tool	0.00	NRTH	-0.60	-0.60	-0.60	0.00
		EAST	-0.51	-0.51	-0.51	0.00
		POLEQUI	0.71	0.71	0.71	0.00

CLUSTER NUMBER: 3

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
deb	0.02	NRTH	-0.44	-0.44	-0.43	0.00
tool	0.02	EAST	-0.73	-0.70	-0.67	0.03
		POLEQUI	-1.13	-1.11	-1.09	0.02

CLUSTER NUMBER: 4

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
tool	0.00	NRTH	-0.44	-0.44	-0.44	0.00
		EAST	-0.73	-0.73	-0.73	0.00
		POLEQUI	-1.94	-1.94	-1.94	0.00

CLUSTER NUMBER: 5

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
point	0.05	NRTH	-0.63	-0.56	0.52	0.05
tool	0.02	EAST	-0.50	-0.49	-0.49	0.01
deb	0.03	POLEQUI	-0.49	-0.46	-0.45	0.02

Table G.10 (Continued).

CLUSTER NUMBER: 6

MEMBERS: CASE	DISTANCE	VARIABLE	STATISTICS: MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.64	-0.64	-0.64	0.00
		EAST	-0.47	-0.47	-0.47	0.00
		POLEQUI	-0.96	-0.96	-0.96	0.00

CLUSTER NUMBER: 7

MEMBERS: CASE	DISTANCE	VARIABLE	STATISTICS: MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.48	-0.48	-0.48	0.00
		EAST	-0.80	-0.80	-0.80	0.00
		POLEQUI	-0.22	-0.22	-0.22	0.00

CLUSTER NUMBER: 8

MEMBERS: CASE	DISTANCE	VARIABLE	STATISTICS: MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.02	NRTH	-0.44	-0.44	-0.44	0.00
tool	0.01	EAST	-0.73	-0.73	-0.72	0.01
tool	0.03	POLEQUI	-0.83	-0.79	-0.73	0.04

CLUSTER NUMBER: 9

MEMBERS: CASE	DISTANCE	VARIABLE	STATISTICS: MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.02	NRTH	-0.44	-0.44	-0.44	0.00
deb	0.02	EAST	-0.73	-0.73	-0.72	0.01
		POLEQUI	-1.42	-1.33	-1.26	0.03

CLUSTER NUMBER: 10

MEMBERS: CASE	DISTANCE	VARIABLE	STATISTICS: MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	-0.48	-0.48	-0.48	0.00
		EAST	-0.71	-0.71	-0.71	0.00
		POLEQUI	0.48	0.48	0.48	0.00

CLUSTER NUMBER: 11

MEMBERS: CASE	DISTANCE	VARIABLE	STATISTICS: MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.02	NRTH	-0.53	-0.53	-0.52	0.01
deb	0.02	EAST	-0.47	-0.46	-0.45	0.01
		POLEQUI	-0.30	-0.27	-0.24	0.03

CLUSTER NUMBER: 12

MEMBERS: CASE	DISTANCE	VARIABLE	STATISTICS: MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	-0.46	-0.46	-0.46	0.00
		EAST	-0.79	-0.79	-0.79	0.00
		POLEQUI	0.07	0.07	0.07	0.00

Table G.10 (Continued).

CLUSTER NUMBER: 13

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
tool	0.03	I	NRTH	-0.48	-0.46	-0.44	0.02
tool	0.03	I	EAST	-0.73	-0.72	-0.71	0.01
		I	POLEQUI	-0.66	-0.62	-0.58	0.04

CLUSTER NUMBER: 14

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
tool	0.02	I	NRTH	-0.56	-0.54	-0.53	0.02
deb	0.02	I	EAST	-0.54	-0.51	-0.49	0.02
		I	POLEQUI	-0.80	-0.79	-0.78	0.01

CLUSTER NUMBER: 15

MEMBERS			STATISTICS				
CASE	DISTANCE	I	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST. DEV.
deb	0.00	I	NRTH	-0.56	-0.56	-0.56	0.00
		I	EAST	-0.54	-0.54	-0.54	0.00
		I	POLEQUI	-0.34	-0.34	-0.34	0.00

Table G.11 K-Means Cluster Analysis for Site LA 51700, Abiquiu Archaeological Study, ACOE, 1989.

THE FOLLOWING RESULTS ARE FOR:
SITE = 51700.000

SUMMARY STATISTICS FOR 13 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
NRTH	0.384	12	0.003	8	87.603	0.000
EAST	1.110	12	0.007	8	99.918	0.000
POLEQUI	5.594	12	0.011	6	257.974	0.000

CLUSTER NUMBER: 1

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.03	NRTH	1.34	1.35	1.37	0.01
tool	0.01	EAST	1.36	1.37	1.39	0.02
deb	0.03	POLEQUI	-0.36	-0.31	-0.28	0.03

CLUSTER NUMBER: 2

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	0.95	0.95	0.95	0.00
		EAST	1.25	1.25	1.25	0.00
		POLEQUI	1.56	1.56	1.56	0.00

CLUSTER NUMBER: 3

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	0.94	0.94	0.94	0.00
		EAST	0.31	0.31	0.31	0.00
		POLEQUI	-0.27	-0.27	-0.27	0.00

CLUSTER NUMBER: 4

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.00	NRTH	1.35	1.35	1.35	0.00
		EAST	1.36	1.36	1.36	0.00
		POLEQUI	-1.20	-1.20	-1.20	0.00

Table G.11 (Continued).

CLUSTER NUMBER: 5

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
tool	0.01	NRTH	1.34	1.36	1.38	0.02
point	0.01	EAST	1.41	1.42	1.42	0.01
		POLEQUI	0.22	0.23	0.24	0.01

CLUSTER NUMBER: 6

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	1.35	1.35	1.35	0.00
		EAST	1.40	1.40	1.40	0.00
		POLEQUI	-0.52	-0.52	-0.52	0.00

CLUSTER NUMBER: 7

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	1.34	1.34	1.34	0.00
point	0.00	EAST	1.38	1.38	1.39	0.01
tool	0.01	POLEQUI	-0.02	-0.02	-0.02	0.00

CLUSTER NUMBER: 8

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.04	NRTH	1.12	1.15	1.18	0.03
point	0.04	EAST	1.27	1.31	1.36	0.04
		POLEQUI	-0.47	-0.43	-0.39	0.04

CLUSTER NUMBER: 9

MEMBERS			STATISTICS			
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.00	NRTH	1.18	1.18	1.18	0.00
		EAST	1.36	1.36	1.36	0.00
		POLEQUI	-0.18	-0.18	-0.18	0.00

Table G.11 (Continued).

CLUSTER NUMBER: 10

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
point	0.03	NRTH	1.15	1.15	1.15	0.00
point	0.03	EAST	1.24	1.24	1.24	0.00
		POLEQUI	0.27	0.31	0.35	0.04

CLUSTER NUMBER: 11

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	1.12	1.12	1.12	0.00
		EAST	1.27	1.27	1.27	0.00
		POLEQUI	-0.30	-0.30	-0.30	0.00

CLUSTER NUMBER: 12

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.02	NRTH	1.36	1.37	1.38	0.01
deb	0.02	EAST	1.37	1.41	1.44	0.04
		POLEQUI	-0.43	-0.42	-0.42	0.00

CLUSTER NUMBER: 13

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
deb	0.00	NRTH	1.35	1.35	1.35	0.00
		EAST	1.44	1.44	1.44	0.00
		POLEQUI	-0.67	-0.67	-0.67	0.00

APPENDIX H

OBSIDIAN DATES USING STEVENSON'S 8.81 um^2 (POLVADERA) AND 7.83 um^2 (OBSIDIAN RIDGE) INDUCED HYDRATION RATES

Dates are calculated using Stevenson's Polvadera and Obsidian Ridge hydration rates in the following way.

Source	Hydration Rate (um^2/1000 years)
Polvadera	8.81 $\sqrt{8.81}$ = 2.968
Obsidian Ridge	7.83 $\sqrt{7.83}$ = 2.798 2.798/2.968 = 0.943

To express the Obsidian Ridge rind thickness as a Polvadera equivalent, the calculations below were used.

Source	Polvadera Equivalent
Polvadera	t_p
Obsidian Ridge	t_o (1/0.943) = 1.060

Based on these hydration factors, estimated maximum age for Polvadera equivalent rind measurements is given by the following formula.

$$\text{years B.P.} = t_p^2\ (1{,}000_p) \qquad (1000/V_p)$$

$$= t_p^2\ (1.000/8.81)$$

$$= t_p^2\ (113.51)$$

The formulae can be used to estimate age as follows. If a Polvadera rim width measures 3.52 um, then simply square the rim width (=12.39) and multiply by 113.51. The resulting age is 1,406 years B.P. or A.D. 580 (the B.P. "present" represents the year the cuts were made, 1986 in this instance). The standard deviation of the measurement in years is obtained by multiplying the standard deviation of the rim width (based on known measurement error factors) times the B.P. date, dividing the result by the measured rim width, and multiplying by two. An alternative method for obtaining the standard deviation would be to calculate directly years represented by the measurement error given in the S.D. column using the method given above (squar the measurement and multiply by 113.51), and then adding this result to the rim width measurement, producing an obsidian hydration date range. For an Obsidian Ridge specimen with measured rim width of 3.52 um, one can obtain the Polvadera equivalent by multiplying by 1.060 (=3.73). Square the result (=13.91) and multiply by 113.51 to obtain a B.P. date of 1,579 or A.D. 407.

Table H.1 Recalibrated Obsidian Hydration Provenience Data, Rim Measurements, and Dates, Using 8.81 um^2/1,000 Years for Polvadera and 7.83 um^2/1,000 Years for Obsidian Ridge for Abiquiu Obsidian Artifacts.[1]

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-288	27042-173-2-240-271	3.52	0.05	POL	1,406/A.D. 580	41
86-289	27042-173-2-240-271	2.43	0.04	POL	670/A.D. 1316	23
86-290	27042-172-2-240-271	3.08	0.04	POL	1,077/A.D. 909	28
86-291	27042-173-2-240-271	3.24	0.04	POL	1,191/A.D. 795	30
86-292	27042-172-2-240-271	3.60	0.03	POL	1,471/A.D. 515	25
86-293	27042-172-2-240-271	3.63	0.03	POL	1,495/A.D. 491	26
86-294	27042-172-2-240-271	3.55	0.05	POL	1,430/A.D. 556	41
86-295	27042-132-2-240-271	3.56	0.05	POL	1,439/A.D. 547	40
86-296	27042-125-2-242-273	4.25	0.03	POL	2,050/6.4. BC	29
86-297	27042-122-2-243-272	3.54	0.04	POL	1,422/A.D. 564	33
86-298	27042-124-2-243-273	2.45	0.03	POL	681/A.D. 1305	17
86-299	27042-154-2-244-273	8.27	0.03	POL	7,763/5,777 B.C.	57
		4.68	0.03		2,486/500 B.C.	32
86-300	27042-72-3-270-301	3.61	0.03	POL	1,479/A.D. 507	25
86-301	27042-68-3-272-300	3.62	0.03	POL	1,487/A.D. 499	25
86-302	27042-68-3-272-300	3.56	0.03	POL	1,439/A.D. 547	24
86-303	27042-96-4-309-286	4.26	0.06	POL	2,060/74 B.C.	58
86-304	27042-97-4-309-286	4.76	0.03	POL	2,572/586 B.C.	32
86-305	27042-88-4-309-293	4.05	0.03	POL	1,862/A.D. 124	28
86-306	27042-99-4-310-287	4.44	0.09	POL	2,238/252 B.C.	91
86-307	25480-641-1-394-333	4.17	0.03	POL	1,974/A.D. 12	28
		1.78	0.05		360/A.D. 1626	20

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-308	25480-690-1-394-335	3.35	0.05	POL	1,274/A.D. 712	38
86-309	25480-650-1-408-333	3.11	0.03	POL	1,098/A.D. 888	21
86-310	25480-701-1-409-335	2.26	0.01	POL	580/A.D. 1406	5
86-311	25480-703-1-411-335	3.22	0.04	POL	1,177/A.D. 809	29
86-312	25480-570-1-414-330	4.61	0.03	POL	2,412/426 B.C.	32
86-313	25480-604-1-415-331	5.13	0.04	POL	2,987/1,001 B.C.	47
86-314	25480-606-1-416-331	4.74	0.06	POL	2,550/564 B.C.	65
86-315	25480-578-1-419-330	3.48	0.03	POL	1,375/A.D. 611	23
86-316	25480-796-1-419-330	16.14 3.77	0.06 0.03	POL	29,569/27,583 B.C. 1,613/A.D. 373	221 26
86-317	25480-799-1-419-330	3.10	0.03	POL	1,091/A.D. 895	21
86-318	25480-800-1-419-330	2.92	0.02	POL	968/A.D. 1018	13
86-319	25480-90-2-394-300	4.68	0.06	MED	--	--
86-320	25480-801-2-394-300	4.08	0.04	MED	--	--
86-321	25480-91-2-394-301	3.18	0.03	MED	--	--
86-322	25480-93-2-394-303	4.79 3.26	0.03 0.03	MED	--	--
86-323	25480-43-2-396-300	3.67	0.03	POL	1,529/A.D. 457	25
86-324	25480-272-3-382-300	4.70	0.02	MED	--	--
86-325	25480-687-1-391-335	4.17	0.04	POL	1,974/A.D. 12	38
86-326	27018-372-1-101-100	3.43	0.03	POL	1,335/A.D. 651	24
86-327	27018-374-1-101-104	3.61	0.04	POL	1,479/A.D. 507	33
86-328	27018-271-1-106-105	--	--	POL	--	--

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-329	25532-2-114-125-1	3.50	0.03	POL	1,390/A.D. 596	24
86-330	25532-208-2-117-132	3.57	0.04	POL	1,447/A.D. 539	32
86-331	25532-207-2-118-130	2.80	0.03	POL	890/A.D. 1096	19
86-332	25532-286-2-114-125	3.02	0.04	POL	1,035/A.D. 951	28
86-333	25532-83-1-128-107	2.31	0.02	POL	606/A.D. 1380	10
86-334	25532-85-1-128-108	1.77	0.03	POL	356/A.D. 1630	12
86-335	27020-5-1-108-118	4.07	0.04	POL	1,880/A.D. 106	37
86-336	25330-425-1-122-128	4.63	0.05	POL	2,433/447 B.C.	53
86-337	25330-389-1-120-128	4.33	0.03	POL	2,128/142 B.C.	30
86-338	25330-405-1-121-127	4.89	0.03	POL	2,714/728 B.C.	34
86-339	25330-172-1-108-125	4.86	0.05	POL	2,681/695 B.C.	56
86-340	25330-325-1-117-129	4.04	0.07	POL	1,853/A.D. 133	64
86-341	51698-71-3-104-90	3.11	0.02	POL	1,098/A.D. 888	14
86-342	51698-33-3-102-91	3.69	0.03	MED	--	--
86-343	51698-41-3-91-93	3.56	0.05	POL	1,439/A.D. 547	40
86-344	51700-224-1-316-293	3.57	0.04	POL	1,447/A.D. 539	32
86-345	51700-66-2-344-309	2.97	0.04	POL	1,001/A.D. 985	27
86-346	51700-16-2-345-302	3.36	0.02	POL	1,281/A.D. 705	17
86-347	51700-73-2-348-309	3.37	0.02	POL	1,289/A.D. 697	15
86-348	27041-45-1-129-109	3.03	0.03	POL	1,042/A.D. 944	21
86-349	27041-129-1-126-107	3.29	0.03	POL	1,229/A.D. 757	22
86-350	27041-104-1-125-108	3.31	0.02	POL	1,244/A.D. 742	15

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-351	27041-91-1-125-114	4.11	0.03	POL	1,917/A.D. 69	29
86-352	27041-186-1-124-114-2	4.63	0.04	POL	2,433/447 B.C.	43
86-353	27041-185-1-124-114-1	2.36	0.03	POL	632/A.D. 1354	16
86-354	27041-186-1-124-114-2	2.72	0.05	POL	840/A.D. 1146	31
86-355	27041-186-1-124-114-1	2.32	0.04	POL	611/A.D. 1375	21
86-356	27041-185-1-124-114	3.54	0.02	POL	1,422/A.D. 564	17
86-357	25328-587-5-87-109	3.82	0.04	POL	1,656/A.D. 330	35
86-358	25328-581-5-87-103	3.99	0.07	POL	1,807/A.D. 179	64
86-359	25328-91-2-105-125	4.06	0.05	POL	1,871/A.D. 115	46
86-360	25328-170-4-46-84	3.10	0.04	POL	1,091/A.D. 895	28
86-361	25328-179-4-45-84	4.13	0.02	POL	1,936/A.D. 50	19
		3.19	0.04		1,155/A.D. 831	29
86-362	25328-206-4-44-83	4.14	0.02	POL	1,946/A.D. 40	18
86-363	25328-393-3-56-150	4.86	0.04	POL	2,681/695 B.C.	46
86-364	25328-442-3-55-152	3.39	0.06	POL	1,304/A.D. 682	47
86-365	25328-443-3-53-152	4.52	0.04	POL	2,319/333 B.C.	41
		5.31	0.04		3,200/1,214 B.C.	49
86-366	25328-425-3-52-153	2.87	0.03	POL	935/A.D. 1051	20
86-367	25328-84-1-153-55	6.08	0.06	POL	4,196/2,210 B.C.	83
		4.06	0.03		1,871/A.D. 115	28
86-368	25328-65-1-151-58	3.75	0.04	POL	1,596/A.D. 390	34
86-369	25328-729-5-95-111	3.55	0.04	POL	1,431/A.D. 555	32
86-370	25328-730-5-95-112	2.63	0.03	POL	785/A.D. 1201	18
86-371	25328-825-6-54-129-1	4.08	0.03	POL	1,890/A.D. 96	27

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-372	25328-691-5-93-104	4.20	0.04	POL	2,002/16 B.C.	39
86-373	25328-688-5-93-101	3.54	0.06	POL	1,422/A.D. 564	49
86-374	25328-695-5-92-104	3.94	0.04	POL	1,762/A.D. 224	36
86-375	25328-655-5-90-109	3.35	0.03	POL	1,274/A.D. 712	23
86-376	25328-632-5-89-111	3.93	0.06	POL	1,753/A.D. 233	54
86-377	25328-629-5-88-110	3.50	0.02	POL	1,390/A.D. 596	16
86-378	25328-627-5-88-108	3.33	0.06	POL	1,259/A.D. 727	45
86-673	27002-2-1-129-112-6	3.56	0.03	POL	1,439/A.D. 547	24
86-674	51700-131-1-295-294-13	3.62	0.02	POL	1,487/A.D. 499	17
86-675	51702-80-2-77-113-4 (C1)	3.00	0.05	POL	1,022/A.D. 964	34
86-675A	51702-80-2-77-113-4 (C2)	--	--	POL	--	--
86-676	51700-53-2-343-306-5	4.42	0.05	POL	2,218/232 B.C.	50
86-677	25330-164-1-108-115-31	4.91	0.04	POL	2,737/751 B.C.	44
86-678	25480-670-1-398-334-40 (C1)	3.11	0.03	POL	1,098/A.D. 888	21
86-679	25480-670-1-398-334-40 (C2)	3.06	0.05	POL	1,063/A.D. 923	35
86-680	51700-34-2-343-304-4	4.01 3.47	0.02 0.03	POL	1,825/A.D. 161 1,367/A.D. 619	19 23
86-681	25480-233-9-394.54-331.88-5	4.62	0.03	POL	2,423/437 B.C.	31
86-682	27042-115-9-301.5-299-8	3.96	0.05	POL	1,780/A.D. 206	45
86-683	27041-99-1-124-108-12	4.51	0.04	POL	2,309/323 B.C.	41

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-684	27018-139-1-101-151-31 (C1)	5.49	0.04	POL	3,421/1,435 B.C.	50
86-685	27018-139-1-101-151-31 (C2)	4.88	0.03	POL	2,703/717 B.C.	34
86-686	25330-591-2-110-99-4	5.48	0.06	POL	3,409/1,423 B.C.	75
86-687	25328-55-1-152-61-3	3.73	0.03	POL	1,579/A.D. 407	26
86-688	25532-36-1-124-109-13 (C1)	4.81	0.04	POL	2,626/640 B.C.	44
86-689	25523-36-1-124-109-13 (C2)	2.99	0.07	POL	1,015/A.D. 971	48
86-690	27020-212-1-113-134-9	4.03	0.03	POL	1,844/A.D. 142	27
86-691	27002-83-1-123-116-4	3.64	0.03	POL	1,504/A.D. 482	25
86-692	27042-50-3-297-301-4 (C1)	4.50	0.05	POL	2,299/313 B.C.	51
86-693	27042-50-3-297-301-4 (C2)	4.51	0.05	POL	2,309/323 B.C.	51
86-694	25330-50-1-103-100-10 (C1)	2.68	0.03	POL	815/A.D. 1171	19
86-695	25330-50-1-103-100-10 (C2)	2.70	0.04	POL	827/A.D. 1159	25
86-696	25532-132-2-109-129-16	3.22	0.04	MED	--	--
86-697	51703-298-9-111-89-14	2.87	0.03	POL	935/A.D. 1051	20
86-698	25480-82-2-396-320-32	2.86	0.03	POL	928/A.D. 1058	20
86-699	27042-103-4-309-290-13	4.06	0.04	POL	1,871/A.D. 115	37
86-700	25328-321-3-60-147-50	3.22	0.04	POL	1,177/A.D. 809	29

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-701	25532-85-1-128-108-3 (C1)	2.75	0.03	POL	858/A.D. 1128	19
86-702	25532-85-1-128-108-3 (C2)	3.54	0.04	POL	1,422/A.D. 564	33
		2.87	0.02		935/A.D. 1051	13
86-703	27041-104-1-125-108-20 (C1)	4.25	0.03	POL	2,050/64 B.C.	29
86-704	27041-104-1-125-108-20 (C2)	3.70	0.04	POL	1,554/A.D. 432	34
		3.03	0.03		1,042/A.D. 944	21
86-705	25328-91-2-105-125-4 (C1)	3.70	0.04	POL	1,554/A.D. 432	34
86-706	25328-91-2-105-125-4 (C2)	3.80	0.03	POL	1,639/A.D. 347	26
86-707	25480-660-1-418-333-39 (C1)	2.63	0.04	POL	785/A.D. 1201	24
86-708	25480-660-1-418-333-39 (C2)	3.16	0.02	POL	1,133/A.D. 853	15
86-709	25328-432-3-58-152-62	3.46	0.04	POL	1,359/A.D. 627	31
86-710	25333-32-1-104-118-1 (C1)	4.05	0.05	POL	1,862/A.D. 124	46
86-711	25333-32-1-104-118-1 (C2)	4.29	0.04	POL	2,090/104 B.C.	38
86-712	25328-451-3-56-153-63	3.54	0.04	POL	1,422/A.D. 564	33
86-713	51700-5-2-344-301-11	2.13	0.03	POL	514/A.D. 1472	16
		3.56	0.03		1,439/A.D. 547	24
86-714	25333-80-1-130-129-4	3.67	0.05		1,529/A.D. 457	42
86-715	25532-83-1-128-107-14 (C1)	0.94	0.03	POL	100/A.D. 1886	7
		3.12	0.03		1,105/A.D. 881	21
86-716	25532-83-1-128-107-14 (C2)	1.87	0.03	POL	397/A.D. 1589	13
		2.72	0.04		840/A.D. 1146	25

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-717	27041-62-1-128-112-4	3.06	0.05	POL	1,063/A.D. 923	35
86-718	25330-89-1-105-104-36	5.77	0.04	MED	--	--
86-719	25328-381-3-52-152-55	5.27 3.88	0.03 0.03	POL	3,153/1,167 B.C. 1,709/A.D. 277	35 26
86-720	25328-379-3-58-150-12	4.42	0.02	POL	2,218/232 B.C.	20
86-721	25328-422-3-55-154-16	3.13	0.04	MED	--	--
86-722	25532-188-2-118-129-9 (C1)	3.32	0.03	POL	1,251/A.D. 735	23
86-723	25532-188-2-118-129-9 (C2)	3.04	0.07	POL	1,049/A.D. 937	49
86-724	25328-386-3-55-150-13	3.81	0.04	POL	1,648/A.D. 338	35
86-725	25480-546-4-369-281-31	4.21	0.02	POL	2,012/26 B.C.	19
86-726	27042-116-9-308.5-244.5-9 (C1)	3.69	0.03	POL	1,546/A.D. 440	25
86-727	27042-116-9-308.5-244.5-9 (C2)	4.87	0.02	POL	2,692/706 B.C.	22
86-728	27041-103-1-125-109-21	4.46	0.05	POL	2,258/272 B.C.	51
86-729	25532-32-1-123-101-12	3.69	0.05	POL	1,546/A.D. 440	42
86-730	25328-345-3-60-153-11	3.40	0.04	POL	1,312/A.D. 674	31
86-731	25480-410-3-368-305-10	3.92	0.05	POL	1,744/A.D. 242	45
86-732	51700-110-1-296-291-7	4.07	0.03	MED	--	--
86-733	25532-96-1-129-113-15	2.24	0.03	POL	570/A.D. 1416	15
86-734	25328-459-9-X-X-24	3.26 2.54	0.04 0.03	POL	1,206/A.D. 780 732/A.D. 1254	30 18
86-735	27018-261-1-107-104-33	--	--	POL	--	--

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-736	27018-389-1-100-122-10	3.76	0.04	POL	1,605/A.D. 381	34
86-737	25333-101-1-137-120-6	5.17	0.02	MED	--	--
86-738	27002-52-1-124-119-7	3.50	0.04	POL	1,390/A.D. 596	32
86-739	27041-116-1-123-111-13 (C1)	3.95	0.02	POL	1,771/A.D. 215	18
86-740	27041-116-1-123-111-13 (C2)	3.60	0.03	POL	1,471/A.D. 515	25
86-741	25328-683-6-53-129-28 (C1)	4.03 3.63	0.03 0.06	MED	--	--
86-742	25328-683-6-53-129-28 (C2)	3.25 4.48	0.04 0.03	MED	--	--
86-743	25328-633-6-53-129-28 (C3)	3.49	0.03	MED	--	--
86-744	27002-9-1-128-112	3.45	0.02	POL	1,351/A.D. 635	16
86-745	27018-479-2-145-7-20 (C1)	4.55	0.06	POL	2,350/364 B.C.	62
86-746	27018-479-2-145-7-20 (C2)	3.79 4.39	0.03 0.04	POL	1,630/A.D. 356 2,188/202 B.C.	26 40
86-747	25328-30-1-148-60-1	3.79	0.05	POL	1,630/A.D. 356	44
86-748	27042-97-4-309-286-12	4.33	0.03	POL	2,128/142 B.C.	30
86-749	25480-585-1-397-331-17	3.64	0.04	POL	1,504/A.D. 482	33
86-750	25480-135-2-393-301-33	4.48	0.07	MED	--	--
86-751	27018-329-1-103-106-47 (C1)	3.20	0.05	POL	1,162/A.D. 824	37
86-752	27018-329-1-103-106-47 (C2)	3.11	0.02	POL	1,098/A.D. 888	14
86-753	27041-106-1-129-110-19	3.38	0.04	POL	1,297/A.D. 689	31

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-754	25330-111-1-106-107-14 (C1)	2.53	0.03	POL	727/A.D. 1259	16
86-755	25330-111-1-106-107-14 (C2)	2.76	0.02	POL	865/A.D. 1121	12
86-756	27041-14-1-118-7	3.89	0.03	POL	1,718/A.D. 268	26
86-757	27002-9-1-128-112-1 (C1)	4.13	0.02	POL	1,936/A.D. 50	19
86-758	27002-9-1-128-112-1 (C2)	3.79	0.04	POL	1,630/A.D. 356	35
86-759	25480-580-1-392-331-38	3.35	0.03	POL	1,274/A.D. 712	23
86-760	27018-349-1-102-100-48	2.91	0.02	POL	961/A.D. 1025	13
86-761	27018-350-1-102-110-49	3.25	0.04	POL	1,199/A.D. 787	30
86-762	25330-48-1-100-118-28 (C1)	3.41	0.04	POL	1,320/AD 666	31
86-763	25330-48-1-100-118-28 (C2)	3.97 3.42	0.03 0.04	POL	1,789/A.D. 197 1,328/A.D. 658	27
86-764	25328-301-3-58.35-144.20-8	2.59	0.03	POL	761/A.D. 1225	18
86-765	25328-821-3-55.15-145.50-45 (C1)	3.04 4.72 3.77	0.04 0.05 0.02	POL	1,049/A.D. 937 2,529/543 B.C. 1,613/A.D. 373	28 54 17
86-766	25328-821-3-55.15-145.50-45 (C2)	3.73	0.04	POL	1,579/A.D. 407	34
86-767	25480-704-1-412-335-22	2.83	0.03	POL	909/A.D. 1077	19
86-768	25532-102-2-114-125-5 (C1)	3.00	0.03	POL	1,022/A.D. 964	20
86-769	25532-102-2-114-125-5 (C2)	2.77	0.03	POL	871/A.D. 1115	19

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-770	27042-114-9-305-299-7	4.44	0.04	POL	2,238/252 B.C.	40
86-771	25532-182-2-104-132-8	2.51	0.02	POL	715/A.D. 1271	12
86-772	51698-64-9-X-X-3	2.46	0.02	POL	687/A.D. 1299	11
86-773	25480-92-2-394-302-1 (C1)	3.00	0.03	POL	1,022/A.D. 964	20
86-774	25380-92-2-394-302-1 (C2)	3.41 2.73	0.03 0.02	POL	1,320/A.D. 666 846/A.D. 1140	23 12
86-775	51703-80-1-118-97-4 (C1)	--	--	OR	--	--
86-776	51703-80-1-118-97-4 (C2)	--	--	OR	--	--
86-777	27018-579-1-104-128	6.65 4.60	0.06 0.03	POL	5,020/3,034 B.C. 2,402/416 B.C.	91 31
86-778	27018-580*	3.35	0.02	POL	1,274/A.D. 712	15
86-779	27018-175*	3.66	0.02	POL	1,521/A.D. 465	16
86-780	51698-71-Level 3	4.52	0.03	MED	--	--
86-781	27018-587*	3.51	0.03	POL	1,398/A.D. 588	24
86-782	27018-588*	--	--	POL	--	--
86-783	51700-226*	3.29	0.04	POL	1,229/A.D. 757	30
86-784	25480-110*	3.84	0.04	POL	1,674/A.D. 312	35
86-785	27042-152-2-242-272	4.41	0.03	POL	2,208/222 B.C.	30
86-786	51700-39-2-346-304	3.60	0.03	POL	1,471/A.D. 515	25
86-787	51700-30-2-344-305	3.22	0.03	POL	1,177/A.D. 809	22
86-788	27002-48-1-126-111	3.62	0.04	POL	1,487/A.D. 494	34

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-789	25328-681-6-53-129-Level 1	4.79	0.04	POL	2,604/618 B.C.	44
86-790	27018-282-1-106-106	3.59	0.05	POL	1,463/A.D. 523	41
86-791	27018-251-1-106-103	3.37	0.04	POL	1,289/A.D. 697	31
86-792	27018-329-1-103-106	3.78	0.03	POL	1,622/A.D. 364	26
86-793	27018-285-1-104-105	3.23	0.04	POL	1,184/A.D. 802	30
86-794	27018-324-1-102-104	4.76	0.05	POL	2,572/586 B.C.	54
86-795	27041-106-1-129-110	2.62	0.09	POL	779/A.D. 1207	55
86-796	25328-234-4-43-83	4.30	0.04	POL	2,099/113 B.C.	39
86-797	27041-118-1-128-108	3.09	0.04	POL	1,084/A.D. 902	28
86-798	27041-114-1-125-110	3.72	0.02	POL	1,571/A.D. 415	17
86-799	25532-201-2-119-130	3.33	0.04	POL	1,259/A.D. 727	30
86-800	27041-57-1-124-112	4.43	0.03	POL	2,228/A.D. 242	30
86-801	25328-628-5-88-109	4.13	0.03	POL	1,936/A.D. 50	28
86-802	25532-219-2-119-133	3.66	0.03	POL	1,521/A.D. 465	25
86-803	27041-67-1-125-112	5.13	0.03	POL	2,987/1,001 B.C.	35
86-804	25328-625-5-89-110	3.23	0.04	POL	1,184/A.D. 802	30
86-805	25328-74-1-153-62	3.40	0.05	POL	1,312/A.D. 674	39
86-806	25328-59-1-152-59	3.21	0.06	POL	1,170/A.D. 816	44
86-807	25328-68-1-152-56	3.75	0.03	POL	1,596/A.D. 390	17
86-808	25328-42-1-150-64	3.35	0.02	POL	1,274/A.D. 712	15
86-809	25328-30-1-148-60-1	--	--	MED	--	--
86-810	25328-653-5-90-107	3.24	0.03	POL	1,192/A.D. 794	22

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-811	25328-470-5-80-107	3.27	0.03	POL	1,214/A.D. 772	22
86-812	25328-656-5-90-110	3.48	0.06	POL	1,375/A.D. 611	47
86-813	27018-110-1-111.4-170.9-3 (C1)	3.26	0.03	POL	1,206/A.D. 780	22
86-814	27018-110-1-111.4-170.9-3 (C2)	3.26	0.02	POL	1,206/A.D. 780	15
86-815	27018-401-1-99.60-123.95-12 (C1)	3.85	0.05	MED	--	--
86-816	27018-401-1-99.60-123.95-12 (C2)	4.28	0.04	MED	--	--
86-817	27018-576-1-105.10-126-28 (C1)	3.65	0.04	POL	1,512/A.D. 474	33
86-818	27018-576-1-105.10-126-28 (C2)	3.44	0.02	POL	1,343/A.D. 643	16
86-819	27018-571-1-106-124.10-26 (C1)	5.56	0.05	POL	3,509/1.523 B.C.	63
86-820	27018-571-1-106-124.10-26 (C2)	--	--	POL	--	--
86-821	27018-284-1-106.90-117.18-6 (C1)	3.09	0.03	POL	1,084/A.D. 902	21
86-822	27018-284-1-106.90-117.18-6 (C2)	2.68	0.04	POL	815/A.D. 1171	24
86-823	27018-110-1-111.40-170.90-2 (C1)	3.36	0.04	POL	1,281/A.D. 705	31
86-824	27018-110-1-111.40-170.90-2 (C2)	4.62	0.03	POL	2,423/437 B.C.	31
86-825	25532-53-1-126-102-2	4.15	0.04	POL	1,955/A.D. 31	38
86-826	25532-192-2-105.25-129.75-10	3.26	0.03	POL	1,206/A.D. 780	22

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-827	27002-22-1-129.9-116.3-2	4.43	0.02	POL	2,228/242 B.C.	20
86-828	27002-109-1-113.95-102.23-5	4.38	0.02	MED	--	--
86-829	27041-95-1-129.98-114.51-2 (C1)	3.35	0.02	POL	1,274/A.D. 712	15
86-830	27041-95-1-129.98-114.51-2 (C2)	3.29	0.03	POL	1,229/A.D. 757	22
86-831	51703-257-2-104.33-90.43-12	12.87	0.07	POL	18,801/16,815 B.C.	205
86-832	25480-794-1-419-339-25	--	--	MED	--	--
86-833	25480-218-2-391-326-4	3.74	0.03	POL	1,588/A.D. 398	25
86-834	25480-192-2-390.80-303.80-3	4.30	0.02	POL	2,099/113 B.C.	20
86-835	25480-714-1-392-336-23	2.81	0.04	POL	896/A.D. 1090	26
86-836	25480-379-3-372.37-304.38-9	5.39	0.05	OR	3,701/1,715 B.C.	69
86-837	25480-271-3-386.65-311.20-6	3.96	0.04	POL	1.780/A.D. 206	36
86-838	25480-515-4-364.90-299.40-13 (C1)	3.34	0.04	POL	1,266/A.D. 720	30
86-839	25480-515-4-364.90-299.40-13 (C2)	3.35	0.03	POL	1,274/A.D. 712	23
86-840	25480-680-1-413.50-334.40-21	3.35	0.04	POL	1,274/A.D. 712	30
86-841	25333-134-9-X-X-8	4.07	0.03	POL	1,880/A.D. 106	28

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-842	25330-64-1-103.53-106.25-12	--	--	OR	--	--
86-843	27020-108-1-106.85-103.05-11 (C1)	3.38	0.03	POL	1,297/A.D. 689	23
86-844	27020-108-1-106.85-103.05-11 (C2)	3.12	0.03	POL	1,105/A.D. 881	21
86-845	27041-184-1-129.10-101.80-1	3.84	0.03	POL	1,674/A.D. 312	26
86-846	27020-244-1-120-123-13	2.71	0.04	POL	834/A.D. 1152	25
86-847	27020-245-1-100-145-14	3.46	0.07	POL	1,359/A.D. 627	55
86-848	27020-243-1-120-145-12 (C1)	5.07	0.05	POL	2,918/932 B.C.	58
86-849	27020-243-1-120-145-12 (C2)	--	--	POL	--	--
86-850	51698-20-9-X-X-1	7.21 4.29	0.05 0.02	MED	--	--
86-851	51698-91-4-119.40-135-7 (C1)	2.15	0.04	POL	525/A.D. 1461	20
86-852	51698-91-4-119.40-135-7 (C2)	2.48	0.04	POL	698/A.D. 1288	23
86-853	51698-70-3-104-90-5	2.31	0.04	MED	--	--
86-854	51700-223-1-323.61-301.50-10 (C1)	3.43	0.03	OR	1,504/A.D. 482	26
86-855	51700-223-1-323.61-301.50-10 (C2)	3.13	0.06	OR	1,251/A.D. 735	48
86-856	51700-196-9-320.60-290.61-9 (C1)	4.47	0.03	POL	2,268/282 B.C.	30
86-857	51700-196-9-320.60-290.61-9 (C2)	4.61	0.04	POL	2,412/426 B.C.	42

Table H.1 (Continued).

Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-858	51700-60-2-347.79-307.63-6	4.40	0.03	POL	2,198/212 B.C.	30
86-859	51700-12-2-342.66-303.23-2 (C1)	3.80	0.04	--	--	--
86-860	51700-12-2-342.66-303.23-2 (C2)	3.80	0.03	--	--	--
86-861	25328-815-9-69.70-89.40-42 (C1)	6.69 3.77	0.05 0.03	MED	--	--
86-862	25328-815-9-69.70-89.50-53 (C2)	4.12 3.76	0.03 0.03	MED	--	--
86-863	25328-816-5-81.88-99.75-43 (C1)	3.17	0.05	MED	--	--
86-864	25328-816-5-81.88-99.75-43 (C2)	3.10	0.04	MED	--	--
86-865	25328-458-9-X-X-23 (C1)	3.97	0.03	MED	--	--
86-866	25328-458-9-X-X-23 (C2)	4.07	0.04	MED	--	--
86-867	25328-248-4-42.27-92.93-7	3.15	0.04	POL	1,126/A.D. 860	29
86-868	25328-456-9-X-X-21	4.22	0.03	MED	--	--
86-869	25328-196-4-44.48-96.18-6	5.07	0.04	POL	2,918/932 B.C.	46
86-870	25328-450-3-54.46-153.81-19	4.48	0.05	POL	2,278/292 B.C.	51
86-871	27042-79-3-363-300-6 (C1)	4.39	0.03	POL	2,188/202 B.C.	30
86-872	27042-79-3-363-300-6 (C2)	4.42	0.03	POL	2,218/232 B.C.	30

Table H.1 (Continued).

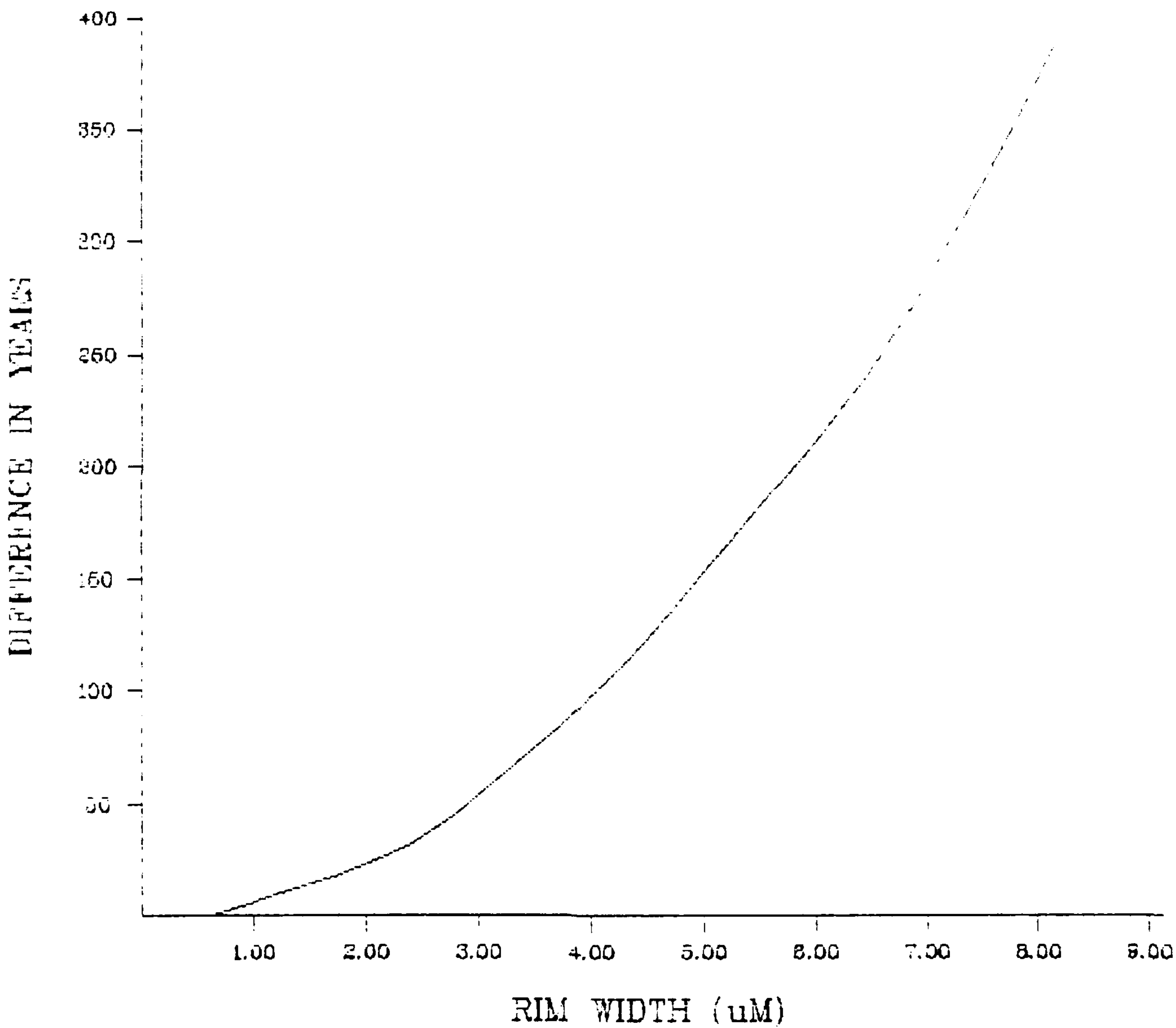
Lab No.	Provenience (Site-Lot-Unit-NGrid-EGrid-[Artifact No.])	Rim Width	S.D.	Group	Date B.P./ Calendar Date	Date S.D.
86-873	27042-12-1-305-338-2 (C1)	4.25	0.03	POL	2,050/64 B.C.	29
86-874	27042-12-1-305-338-2 (C2)	--	--	POL	--	--
86-875	27042-117-9-X-X-10 (C1)	6.16	0.05	POL	4,307/2,321 B.C.	70
86-876	27042-117-9-X-X-10 (C2)	3.30	0.04	POL	1,236/A.D. 750	30

1 POL = Polvadera Peak
MED = Cerro del Medio (no reliable hydration rate available so no dates calculated)
OR = Obsidian Ridge

(C1) = Cut 1
(C2) = Cut 2

* or X = Provenience information missing

Figure H.1 Difference in Polvadera Obsidian Date Using 8.81 um^2 (Stevenson's Recent Induced Hydration Rate) and 8.39 um^2 (Bertram's Rate).



APPENDIX I

CLUSTER ANALYSIS, COLLECTION UNIT ASSEMBLAGES

Table I.1 Cluster Analysis, Collection Unit Assemblages.

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
CLUSTER NUMBER: 1						
25328-3	0.12	PEDER	0.63	0.84	0.99	0.11
25328-4	0.10	BFLK	0.00	0.08	0.22	0.05
25328-5	0.05	HEAT	0.47	0.70	0.91	0.14
25330-1	0.10	CRTX	0.01	0.09	0.41	0.09
25330-2	0.10					
27002-1	0.10					
27004-1	0.13					
27018-1	0.09					
27018-2	0.11					
27020-1	0.09					
27041-1	0.12					
27042-1	0.13					
51698-2	0.13					
51699-1	0.18					
51700-1	0.03					
51701-2	0.10					
51702-1	0.08					
51702-2	0.08					
51703-1	0.06					
51703-2	0.09					
51703-3	0.10					
CLUSTER NUMBER: 2						
25333-1	0.11	PEDER	0.01	0.40	0.55	0.15
25480-1	0.06	BFLK	0.05	0.11	0.26	0.06
25480-2	0.05	HEAT	0.63	0.82	1.00	0.12
25480-3	0.09	CRTX	0.01	0.06	0.17	0.04
25480-4	0.12					
25532-1	0.09					
25532-2	0.08					
27042-2	0.22					
27042-3	0.08					
27042-4	0.09					
51698-1	0.08					
51700-2	0.08					
CLUSTER NUMBER: 3						
51701-1	0.00	PEDER	0.81	0.81	0.81	0.00
		BFLK	0.08	0.08	0.08	0.00
		HEAT	0.17	0.17	0.17	0.00
		CRTX	0.09	0.09	0.09	0.00

Table I.1 (Continued).

MEMBERS		STATISTICS				
CASE	DISTANCE	VARIABLE	MINIMUM	MEAN	MAXIMUM	ST.DEV.
CLUSTER NUMBER: 4						
25328-1	0.05	PEDER	0.17	0.24	0.30	0.07
25328-2	0.05	BFLK	0.03	0.05	0.08	0.02
		HEAT	0.39	0.46	0.53	0.07
		CRTX	0.03	0.05	0.07	0.02

SUMMARY STATISTICS FOR 4 CLUSTERS

VARIABLE	BETWEEN SS	DF	WITHIN SS	DF	F-RATIO	PROB
PEDER	1.862	3	0.545	32	36.456	0.000
BFLK	0.008	3	0.105	32	0.789	0.509
HEAT	0.572	3	0.598	32	10.205	0.000
CRTX	0.010	3	0.177	32	0.602	0.619